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BULLETIN No. 183-2

RIVERSIDE COUNTY FLOOD HAZARD INVESTIGATION— MURRIETA CREEK

MAY 1975

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BULLETIN No. 183-2

RIVERSIDE COUNTY
FLOOD HAZARD INVESTIGATION—
MURRIETA CREEK

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FOREWORD

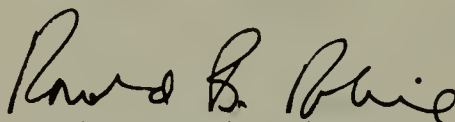
With the urbanization of Southern California, residents have moved afield from urban centers in search of suitable building sites. As a consequence, hillsides have been cleared, grasslands have been paved, and the floodplains of rivers and creeks have been populated. The periodic floods that may once have done little permanent damage have become possible disasters.

Recognizing the hazard posed by construction in floodplains, the Department of Water Resources has undertaken a series of cooperative studies with local agencies to evaluate the extent of this potential danger.

The study of flood hazards along Murrieta Creek in Riverside County reported in this bulletin is one such cooperative investigation. It was requested by the Riverside County Flood Control and Water Conservation District and was financed with matching funds by the Department and the County.

This flood hazard investigation covers Murrieta Creek from Slaughterhouse Canyon to its confluence with Santa Margarita River in Riverside County. A portion of two tributaries, Warm Springs Creek and Santa Gertrudis Creek, is also covered. The report consists of maps delineating the areas of potential inundation from a flood of 100-year recurrence interval, water surface and streambed profiles, and descriptions of how these were determined.

Special appreciation for assistance and cooperation in this study is due the U. S. Geological Survey and Riverside County Flood Control and Water Conservation District.



Ronald B. Robie, Director
Department of Water Resources
The Resources Agency
State of California

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| 2 ...Reach B, Murrieta Creek | 6 ...Reach F, Murrieta Creek |
| 3 ...Reach C, Murrieta Creek | 7 ...Reach G, Murrieta Creek |
| 4 ...Reach D, Murrieta Creek,
Santa Gertrudis Creek and
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| | 9 ...Reach I, Murrieta Creek |
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State of California
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DEPARTMENT OF WATER RESOURCES

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CHAPTER I. INTRODUCTION

Accelerated growth in Riverside County during the past few decades has resulted in extensive development of the floodplains in the county. Although flood control works have been constructed to protect many areas, developments on lands within the floodplains have increased faster than the protective works. As a result, recurrent floods in recent times have caused extensive damage in many places.

Recognizing the need to prevent loss of life and reduce damage to property, the Department of Water Resources, at the request of the Riverside County Flood Control and Water Conservation District, undertook this study of flood hazards along Murrieta Creek. The findings will provide local agencies with a basis for developing regulations and flood control plans to safeguard lives and property within this floodplain.

Objective and Scope of Investigation

The objective of the investigation is to delineate areas of potential inundation from a flood of 100-year frequency, so that local agencies can take appropriate action for flood control and floodplain management along Murrieta Creek. A flood of 100-year frequency is defined as a peak flow that can be expected to be equaled or exceeded on the average of once every 100 years. However, this does not imply the recurrence of such a flood at uniform 100-year intervals, but rather the probability that a 100-year flood may occur or may be exceeded within any one-year period is 1 percent.

A study of the characteristics of the entire watershed was essential

to the investigation in order to determine the flood magnitude.

The study area within the watershed encompasses Murrieta Creek from Slaughterhouse Canyon to its confluence with Santa Margarita River, including portions of the two major tributaries, Santa Gertrudis Creek and Warm Springs Creek.

Data used in the investigation came from the Department of Water Resources, the Riverside County Flood Control and Water Conservation District, the U. S. Geological Survey, the National Weather Service, and the U. S. Army Corps of Engineers.

Area of Investigation

The study area is in western Riverside County about 5 miles south of the City of Elsinore and consists of a portion of the Murrieta Creek watershed. (See Figures 1 and 2.) It covers Murrieta Creek southeastward from Slaughterhouse Canyon to its confluence with Santa Margarita River, a length of approximately 11 miles. It also includes the two major tributaries of Murrieta Creek, Santa Gertrudis Creek and Warm Springs Creek, from their confluence with Murrieta Creek to Escondido Freeway (Interstate 15).

The present population of the study area is estimated to be less than 4,000. The principal business activities are dry land farming and horse and cattle ranching. Some commercial, industrial, and residential land uses are found in the unincorporated communities of Temecula and Murrieta, which also lie within the floodplain. A large portion of the drainage area consists of valley and mesa lands

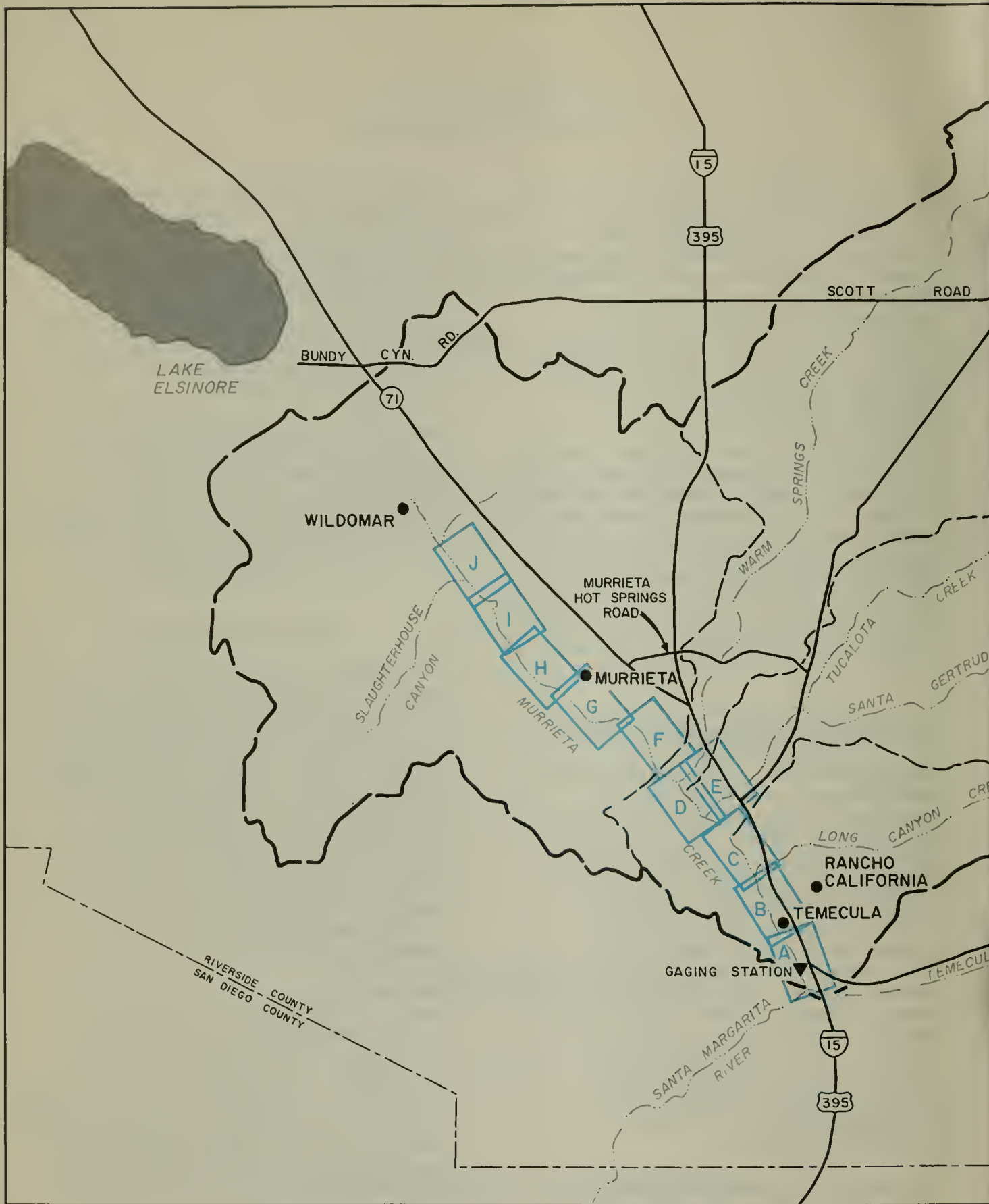
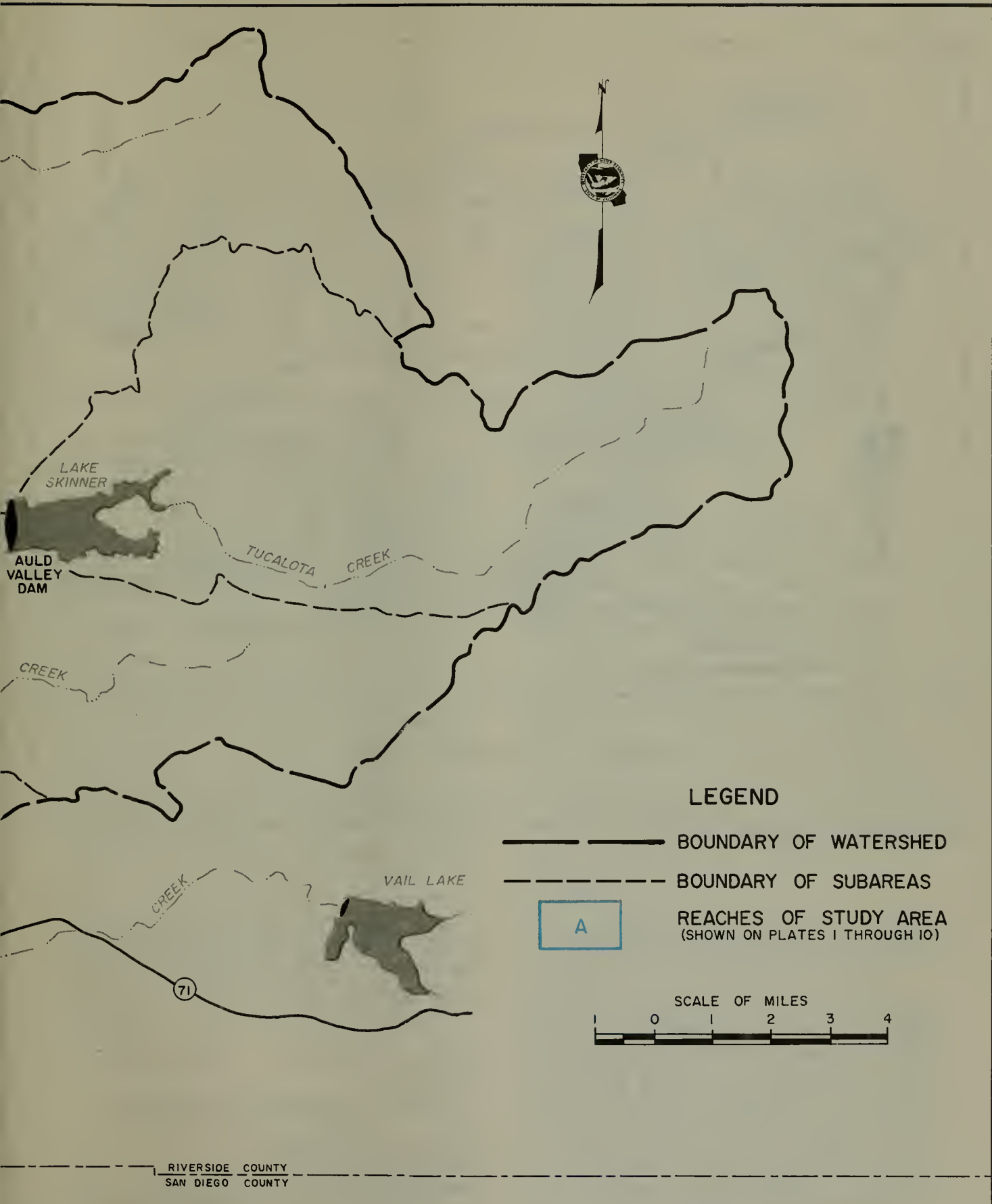


Figure 1—MURRIETA CREEK



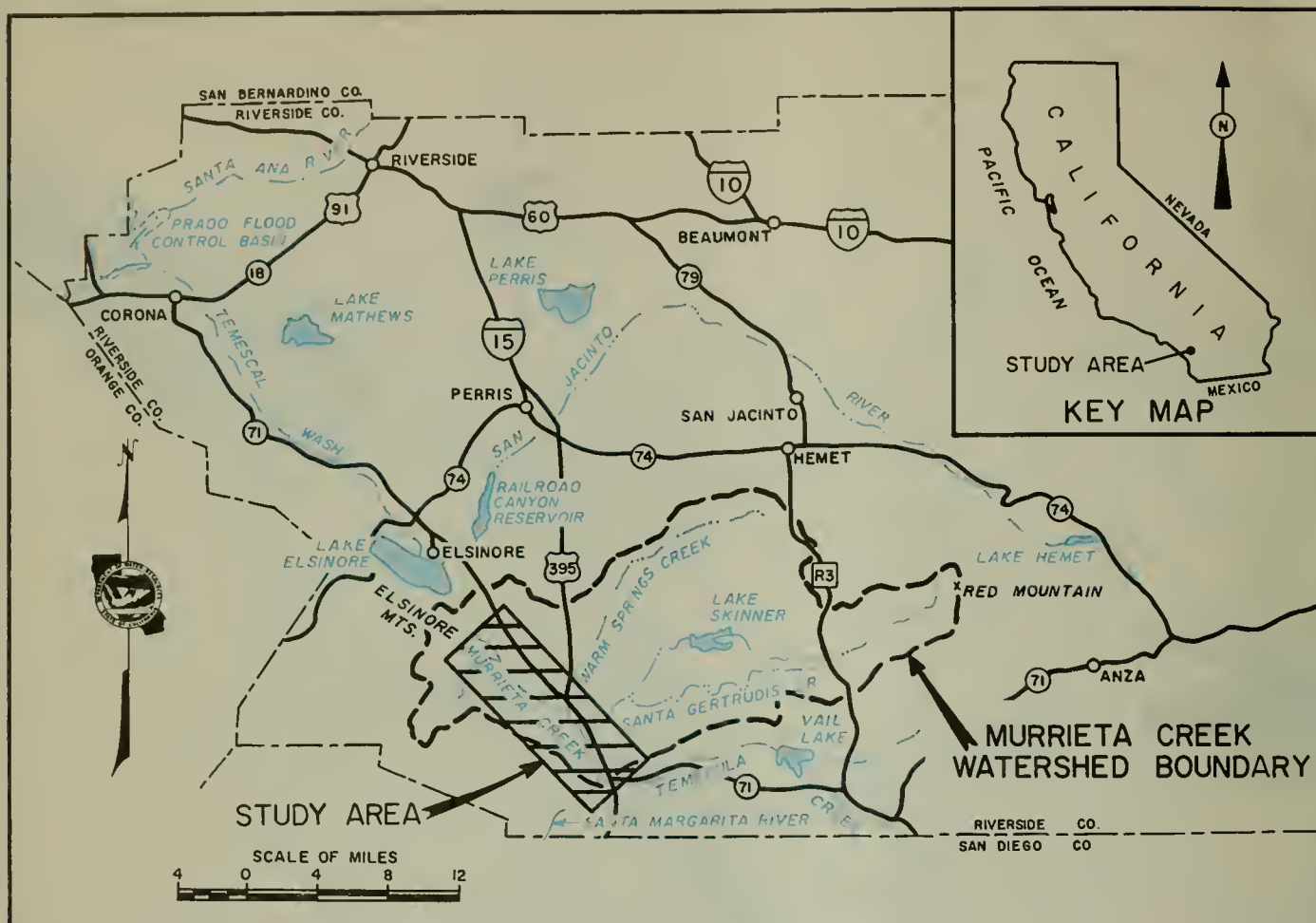


FIGURE 2—VICINITY MAP

DEPARTMENT OF WATER RESOURCES, SOUTHERN DISTRICT, 1974

which, for the most part, lie at elevations between 1,000 and 1,500 feet above sea level.

In 1964, the Rancho California Corporation began development of a planned community within a portion of the watershed. Areas were set aside within this development and designated for homesites, business establishments, light industry, agriculture, ranches, and recreation. The present population of Rancho California is about 2,000.

A land use survey by the Department in 1967 indicated the following land use pattern for the Murrieta Creek watershed:

Urban and Suburban	1,130 acres
Irrigated Agriculture	6,980 acres
Others (nonirrigated agriculture, native vegetation and unclassified)	133,710 acres

CHAPTER II. PHYSICAL CONDITIONS

To determine the areas of inundation that may be expected as a result of flooding, one must look at the characteristics of (1) the storms, (2) the watershed contributing runoff, and (3) the streambed and floodplain.

Climate and Storm Characteristics

The climate in this region is typically Mediterranean, being characterized by warm, dry summers and cool winters with most of the precipitation falling during the 4-month period from December through March. Precipitation is generally in the form of rainfall, but snow is common on the mountain ridges. A total of 3 feet of snow has been reported in a single season at Anza. Mean annual precipitation ranges from less than 10 inches near Vail Lake to more than 40 inches west of Palomar Observatory, varying with elevation and topographic influences. At Wildomar station, (T7S, R4W, Sec. 3, San Bernardino Meridian), which is located approximately 2.5 miles upstream of the study area, the average rainfall was about 13 inches for the period 1915 to 1972. The principal source of winter precipitation in this area is maritime air masses from the Pacific Ocean. There are also infrequent summer storms, which generally owe their origin to the tropical air masses developed over the warm water of the Caribbean Sea and the Gulf of Mexico.

Watershed Characteristics

Murrieta Creek has a drainage area of 220 square miles and is approximately 13.5 miles in length with a mean slope of 110 feet per

mile. Murrieta Creek is bordered by gentle slopes; on the southwest, they rise to the steep foothills of the Elsinore Mountains and on the northeast to a wide area of rolling hills. The extreme elevations of the watershed are approximately 960 feet at the confluence of Murrieta Creek and Santa Margarita River and 4,570 feet at the peak of Red Mountain which forms part of the eastern boundary of the watershed.

Coniferous trees are the predominant vegetation on the higher mountains. Moderately dense growths of chaparral cover the lower mountains and foothills. Small trees, principally oaks, grow in the upper valleys, and willows, cottonwoods, and sycamores grow along the creeks. Warm Springs Creek and Santa Gertrudis Creek are the two major tributaries within the watershed. Warm Springs Creek has a drainage area of 55.6 square miles. The mean slope is approximately 50 feet per mile with a length of approximately 18.7 miles. Santa Gertrudis Creek has a drainage area of 85.4 square miles. The mean slope is 80 feet per mile with a length of 26 miles.

Within the Santa Gertrudis watershed, The Metropolitan Water District of Southern California has recently completed (in operation since April 1973) the construction of Auld Valley Dam. The dam constructed on Tocalota Creek, a principal tributary to Santa Gertrudis Creek, creates Lake Skinner, which is a water supply and regulatory reservoir with a capacity of 42,000 acre-feet. The drainage area behind the reservoir encompasses approximately 51 square miles, which is 60 percent of the entire Santa

Gertrudis Creek watershed. Although the reservoir does not have any available flood control storage, the outflow is less than the inflow as can be seen on Figure 10, because of surcharge storage above the spillway level.

Streambed and Floodplain Characteristics

In the Murrieta Creek Valley, the ancient crystalline rocks are covered by thick beds of gravel and sandy-clay shale, which probably were deposited prior to Santa Margarita River's cutting its outlet through the mountains to the ocean. Recent alluvium lies along the stream channels. In the lower reach of Murrieta Creek (a short reach) the streambed is covered by boulders of various sizes and deposits of gravel, sand, and clay. For the rest of the Creek, the stream is fairly clean with a sandy bottom and light vegetative growth in the channel.

The tributaries feeding the Murrieta Creek streambed are on relatively steep slopes; however, Murrieta Creek itself is on comparatively flat terrain.

The existing Murrieta Creek flood channel was built by Riverside County in 1939, following the damaging floods of 1938. For the next 25 years virtually no improvements were made to the channel. By 1969 both bank erosion

and channel aggradation had taken place, reducing the flood-carrying capacity considerably. That year the Riverside County Flood Control and Water Conservation District embarked upon a program of clearing the channel and deepening and widening it to provide additional capacity. The channel improvements extended from a point downstream of the town of Temecula to a point near Kalima Street in Murrieta.

Because the streambed gradient is relatively flat throughout most of the study reach and because of rock outcroppings in the vicinity of the gaging station near Temecula, the natural streambed gradient tends to be limited to a point where aggradation is considered to be a problem. Also two significant points where aggradation is of the greatest concern to the floodflow characteristics of the Murrieta Creek Channel are the junctions of Warm Springs and Santa Gertrudis Creeks. Moderate floodflows from either of these tributaries historically deposit sand in the main Murrieta Creek Channel at these points.

Aggradation of the stream channel caused by floodflows is difficult to predict and is not reflected in the determination of the water surface profile. However, in estimating the peak discharges, bulking due to sediment and debris carried by floodwater was considered and is reflected in the water surface profile.

CHAPTER III. FLOOD ANALYSES

By analyzing the records of floods in the area, their recurrence intervals can be determined and the peak discharge for the flood of 100-year recurrence interval can be estimated.

Historical Floods

Major floods have caused substantial physical damages and economic losses to businesses and properties. Although no stage or discharge records are available, probably the greatest known flood in the Santa Margarita River Basin was that in January 1862, with the second greatest in February of 1884 (Bulletin No. 57, "Santa Margarita River Investigation, Volume 1, State of California").

The most recent major floods in Riverside County were in January and February of 1969, at which time the county suffered up to \$40,000,000 in damages to public and private facilities. Physical damages along Murrieta Creek and the cost of emergency measures amounted to nearly \$170,000, as estimated by the U. S. Army Corps of Engineers. Before the 1969 floods, the last major floods of memory were in January 1916, March 1938, and January 1943.

Table 1 shows peak discharges of record for the gaging station "Murrieta Creek at Temecula", which is located 0.4 mile upstream from the mouth of the creek and 1.0 mile south of Temecula. (Values for peak discharges obtained from U.S.G.S.data.)

Determination of Peak Discharges

Peak discharges were determined at points on Murrieta Creek as shown

on Table 2. These peak discharges were determined by developing flood hydrographs for each of the major tributaries and successively adding these hydrographs working downstream to the mouth of Murrieta Creek. The peak discharges for the tributaries are given in Table 3. The hydrographs were patterned after the January 1969 flood. Knowing the 24-hour rainfall the investigators synthesized the recorded hydrograph by distributing the 24-hour rainfall and estimated loss rate.

The same distribution factors and loss rates were then applied to a 24-hour 100-year frequency rainfall, and flood hydrographs were synthesized for the major tributaries. The 24-hour 100-year frequency rainfall was selected to determine the peak discharge as opposed to the 6-hour thunderstorm type of rainfall. The reason is that past major floods resulted from storm patterns with a duration of 24 hours or longer. The peak discharges used in development of these hydrographs were considered to have a recurrence interval of once in 100 years. The peak discharge of Murrieta Creek at Temecula estimated by the above method compares favorably with the peak discharge determined from the discharge-frequency curve developed for that station (Figure 11 in the Appendix). The appendix contains more detailed discussion of the method used to determine peak discharges.

Determination of Areas of Potential Inundation

To determine the areas of potential inundation, the water surface elevations along Murrieta Creek and

TABLE 1
PEAK DISCHARGES OF RECORD
MURRIETA CREEK AT TEMECULA
(RECORDS FIRST
KEPT IN 1924)

<i>Date</i>	<i>Peak Discharge, CFS</i>
2-25-69	10,400
1-25-69	6,600
12-29-65	5,020
4-1-58	5,740
3-16-52	6,300
1-16-52	9,140
1-23-43	17,500
12-24-40	7,140
1-8-40	7,550
3-2-38	16,800
1-4-16	23,300*
* Estimated from high water mark	

TABLE 2
100-YEAR PEAK DISCHARGES, MURRIETA CREEK

<i>Location</i>	<i>Discharge, CFS</i>
Upstream of Warm Springs Creek Tributary	9,700
Upstream of Santa Gertrudis Creek Tributary	19,300
Upstream of Long Valley Tributary	28,500
Upstream of confluence with Santa Margarita River	30,900

TABLE 3
100- YEAR PEAK DISCHARGES FROM TRIBUTARIES

<i>Tributary at Confluence with Murrieta Creek</i>	<i>Discharge, CFS</i>
Warm Springs Creek	9,600
Santa Gertrudis (excluding Auld Valley Dam Drainage Area)	6,200
Santa Gertrudis Creek	10,000
Long Valley Tributary	2,500

its tributaries were computed for the peak discharges shown in Table 2. Using maps furnished by the county (scale 1 inch equals 200 feet and contour intervals of 4 feet), cross sections along the stream were taken at maximum intervals of 500 feet.

To compute the water surface elevations, the Energy Equation was used to determine total energy at each cross section and Manning's formula was used to determine the friction loss between cross sections. Calculations were carried out by computer using U. S. Army Corps of Engineers HEC 2 program, with change in velocity head between sections limited to 0.5 foot. Interpolated cross sections were used where the difference in velocity head exceeded 0.5 foot.

For computations, each cross section was then subdivided according to its main channel and overflow areas, and the appropriate roughness coefficients were determined from field inspection and assigned to the subdivisions to determine friction losses.

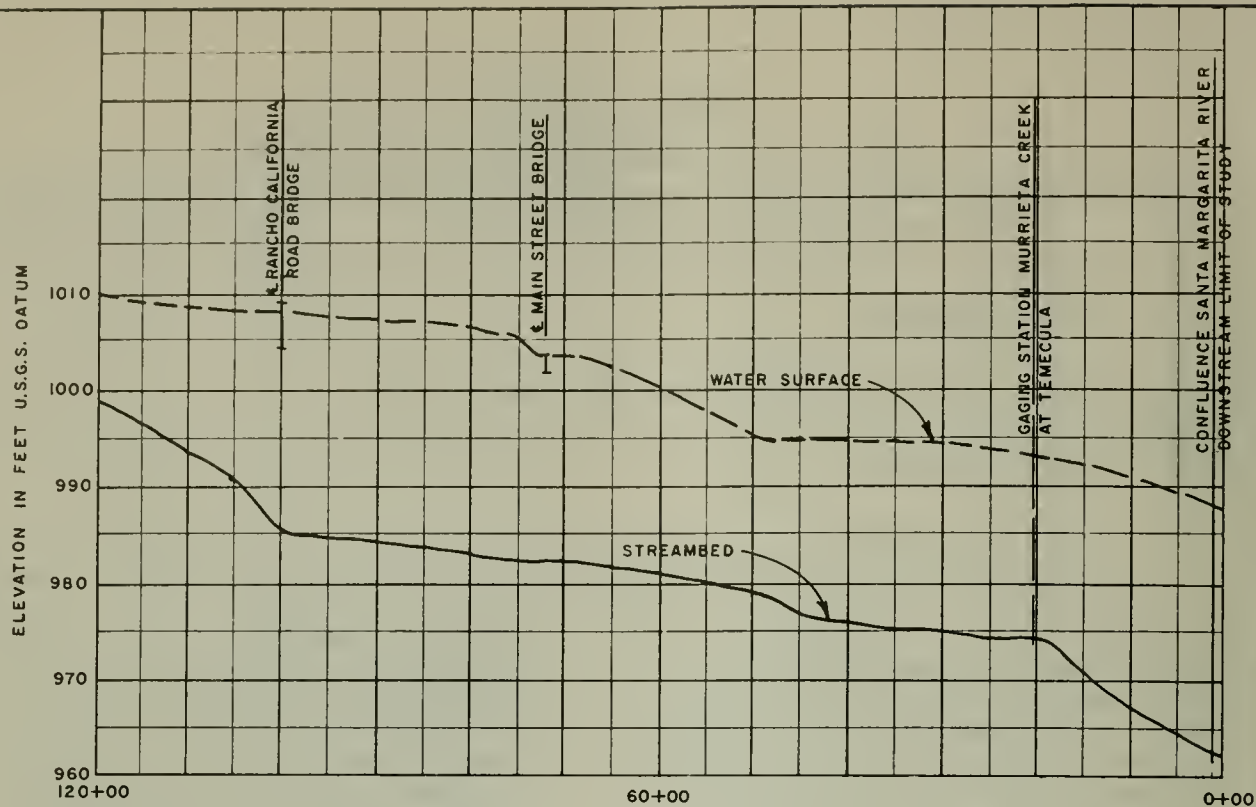
Expansion and contraction losses were also considered to determine head loss between sections.

The computation of water surface elevations was started at a point in the Santa Margarita River that is approximately 2,500 feet downstream

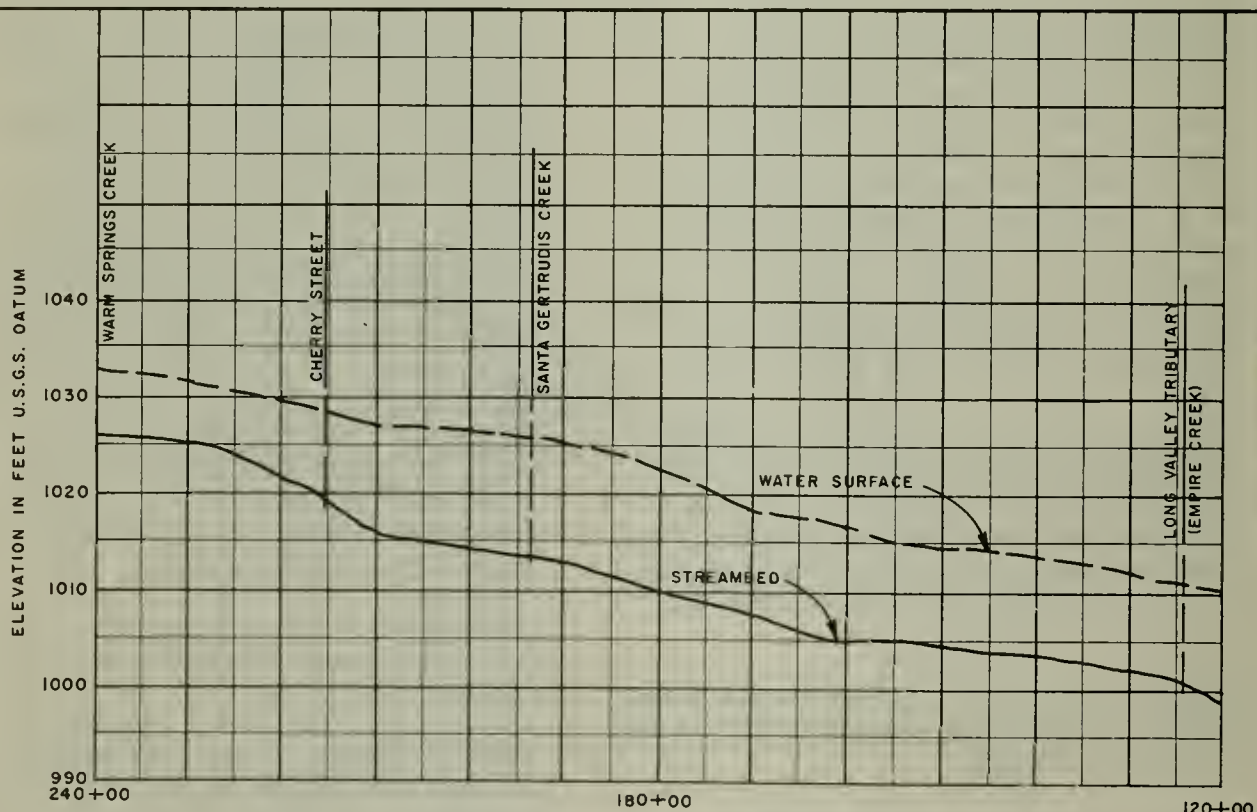
from the confluence of Murrieta Creek with Santa Margarita River. Critical depth and other various initial elevations were studied to determine that the water surface converged to a common elevation at the mouth of Murrieta Creek, thus verifying the starting depth for this study.

The convergence was quite rapid and occurred well downstream of the study area. Figures 3 through 5 show the profiles of the streambed and the computed water surface elevations. The computations indicate that, for all practical purposes, the flow was subcritical throughout the reach. However, at points, the water surface elevations were below critical water surface elevations, indicating the possibility of a hydraulic jump. Further investigation showed that these jumps were of minor undulating nature. Computations were then continued upstream at these locations by assuming critical depth.

During high flow periods the velocity of the streamflow generally ranged from about 7 feet per second to 10 feet per second in the channel and from about 1 foot per second to 5 feet per second in the flooded areas. The depth of flow ranged from approximately 3 feet at the upper end of the study reach to over 20 feet near the downstream portion.



STATION 0+00 TO STATION 120+00



STATION 120+00 TO STATION 240+00

FIGURE 3-ESTIMATED 100-YEAR FLOOD PROFILE:
MURRIETA CREEK (STATION 0+00 TO STATION 240+00)

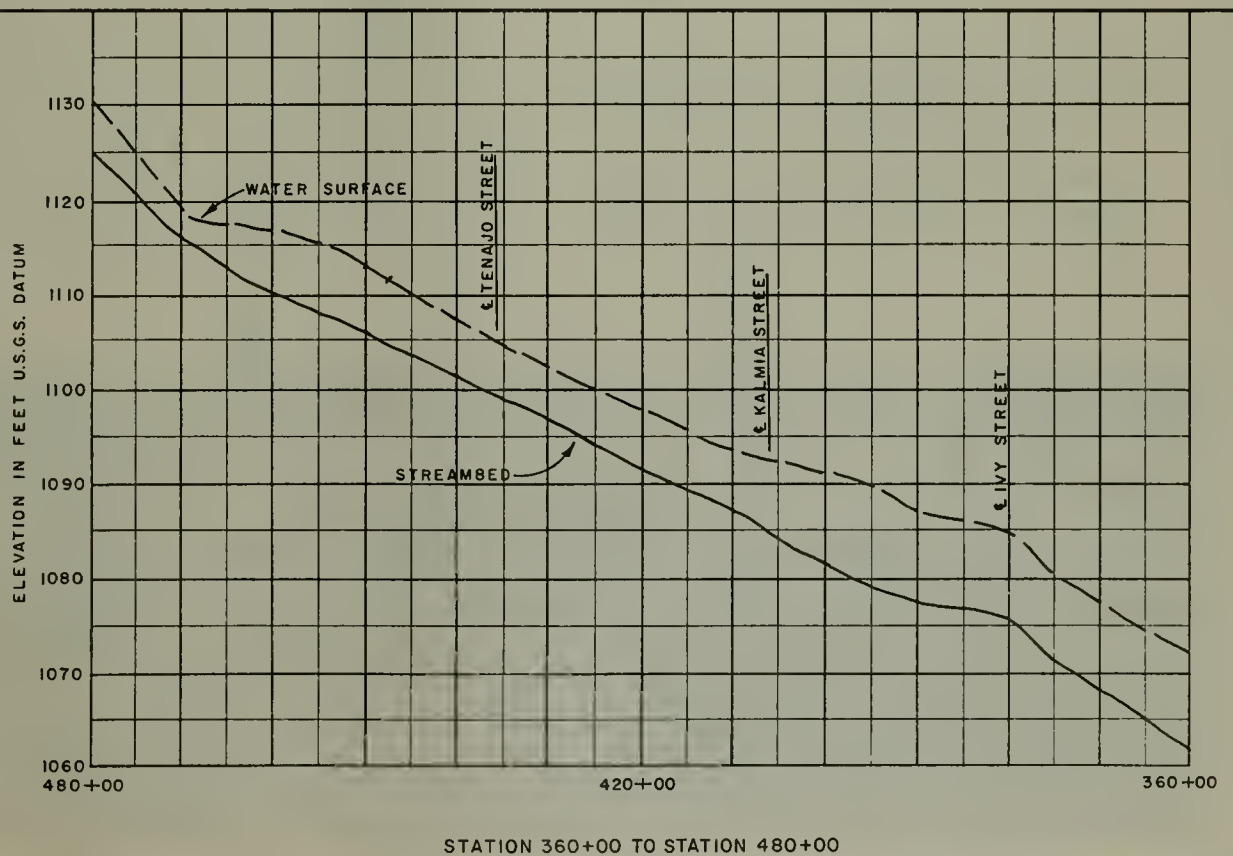
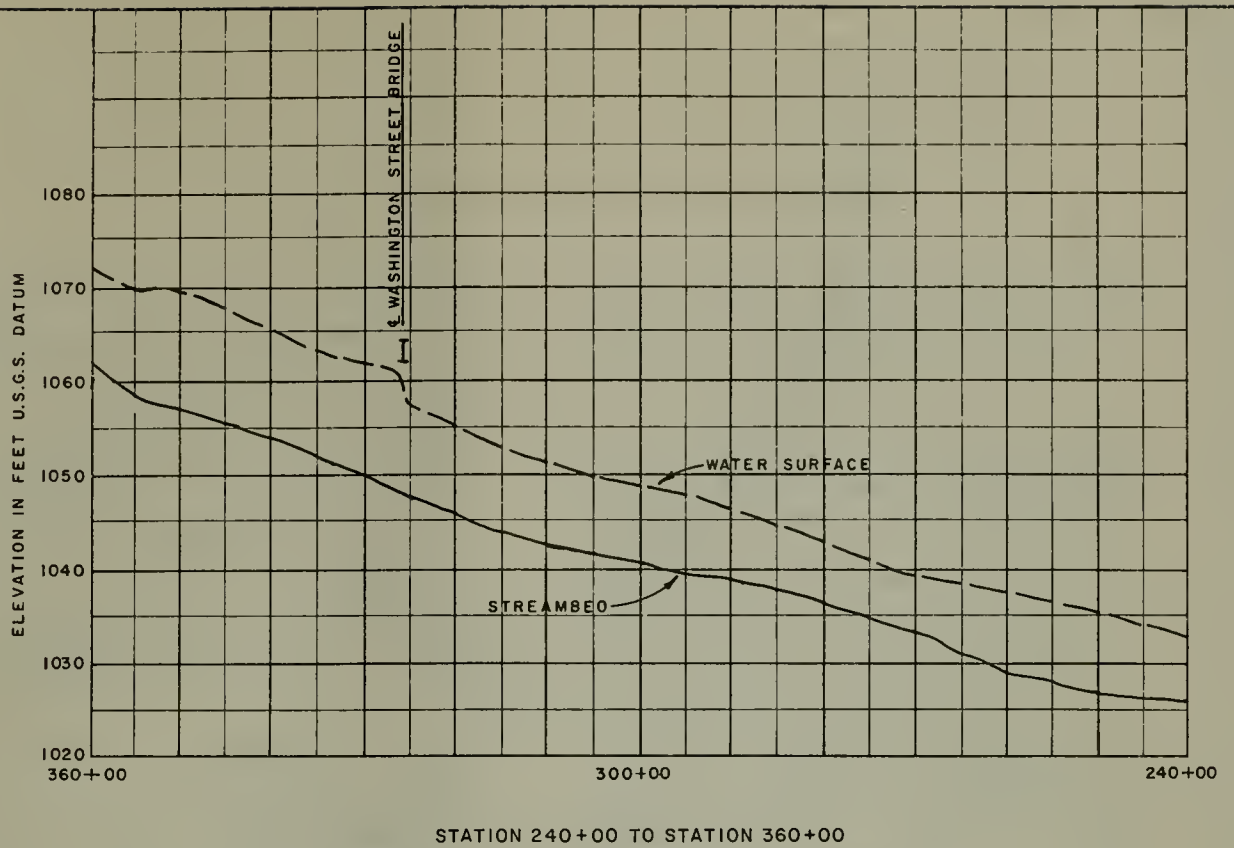


FIGURE 4-ESTIMATED 100-YEAR FLOOD PROFILE:
MURRIETA CREEK (STATION 240+00 TO STATION 480+00)

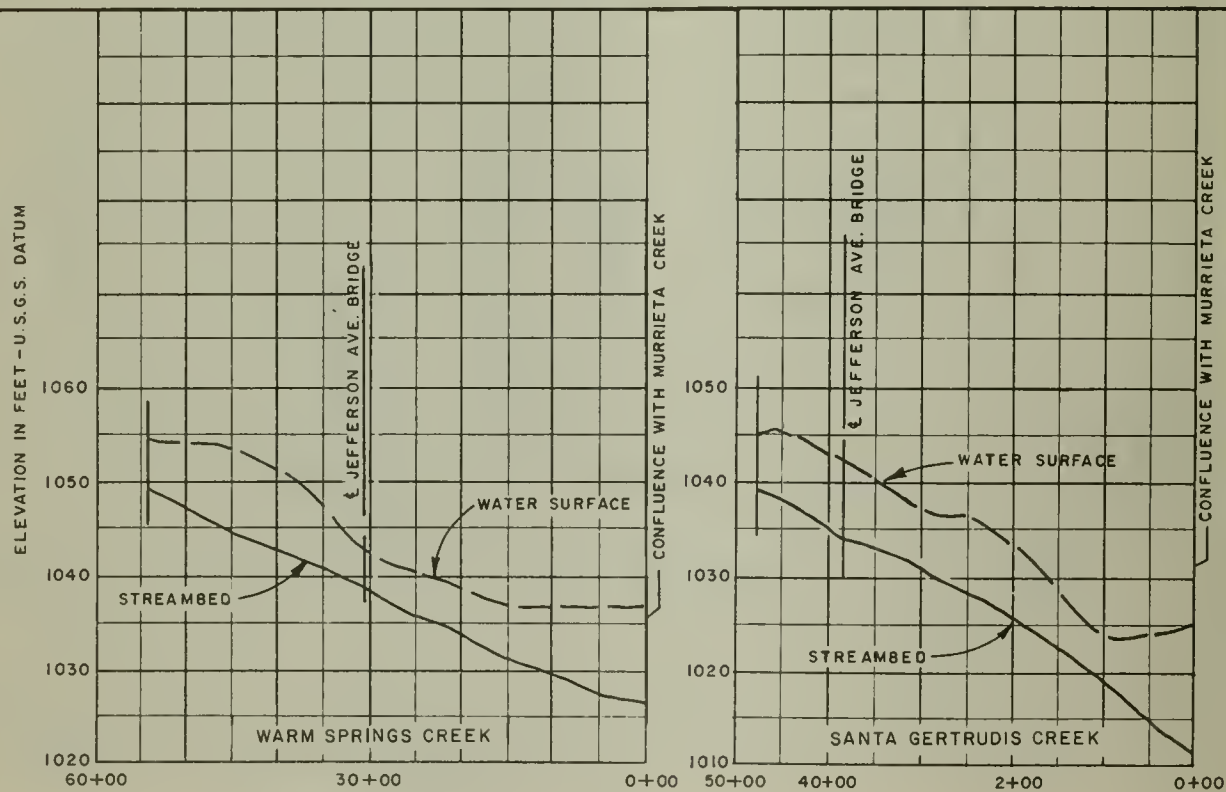
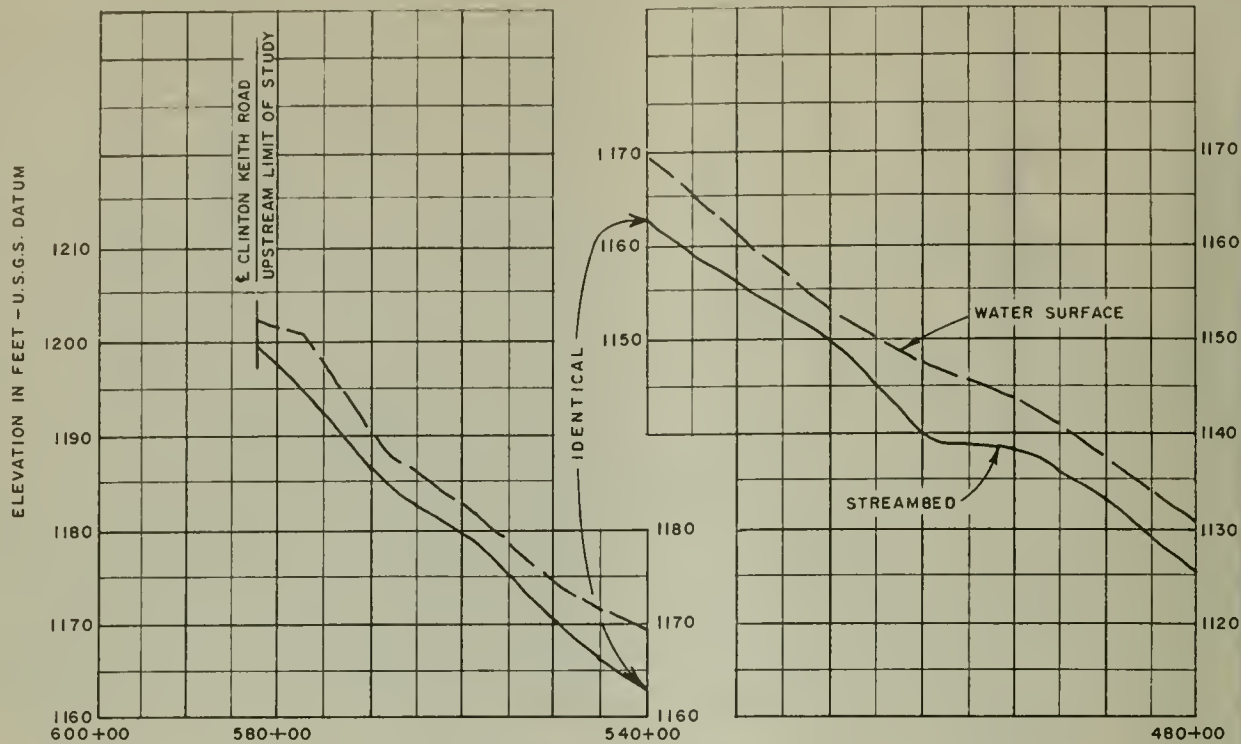


FIGURE 5-ESTIMATED 100-YEAR FLOOD PROFILE:
MURRIETA CREEK (STATION 480+00 TO STATION 586+07)
WARM SPRINGS CREEK, SANTA GERTRUDIS CREEK

CHAPTER IV. AREAS OF POTENTIAL INUNDATION

The computed water surface elevations were plotted on topographic maps furnished by the District, and the areas of potential inundation were delineated. Plates 1 through 10 show areas subject to flooding along Murrieta Creek and in the community of Temecula, as well as the industrial complex between Main Street and Rancho California Road. Many of the roads would be inundated wholly or in part with some overtopping of the bridge crossings at Main Street and Rancho California Road.

Murrieta Creek, as mentioned in Chapter II, had recent channel improvements such as diked sections upstream of Station 160+00. Besides being uncompacted, these dikes were constructed from available streambed materials, consequently they are sandy in nature and appear to be easily erodible. Therefore, the water surface elevations computed and the areas delineated as being inundated are based on the assumption that these dikes have failed throughout.

It can readily be seen that if these dikes were made stable, the areas of potential inundation can be reduced significantly.

Plates 4 and 5 show areas subject to flooding along Santa Gertrudis Creek and Warm Springs Creek. The areas delineated are based on estimated maximum carrying capacity of these two channels, 1,400 cfs and 1,300 cfs, respectively. In both cases, the capacity is considerably less than the estimated peak discharges. As in Murrieta Creek, if the lower reaches of these two channels were improved to carry the peak discharges, the areas subject to flooding could be reduced substantially.

It should be noted that the computed water surface elevations and the areas delineated as being subjected to flooding are based on what exists today. Any changes in the vegetative cover, land uses, and the watershed can alter the results of this study.



100-YEAR FLOOD HEIGHT IN TEMECULA. Left: On Main Street near Front Street. Right: On Front Street at Fifth Street

Appendix

DETERMINATION OF PEAK DISCHARGES

Appendix: DETERMINATION OF PEAK DISCHARGES

Described here is the method utilized in determining peak discharges at points of major tributaries. These peak discharges were based on:

1. Development of a synthetic flood hydrograph representative of a large storm, and
2. Combining of hydrographs of tributaries at confluences.

For development of a representative hydrograph for the study area, a number of storm hydrographs of Murrieta Creek at Temecula were plotted from records as shown on Figure 6. The hydrograph for the January 25, 1969, storm was selected as the representative hydrograph.

Then with the aid of Riverside County Flood Control and Water Conservation District's report on "The Application of Synthetic Unit Hydrograph to Drainage Basins in the Riverside County Flood Control and Water Conservation District", dated January 1965, the January 25, 1969, flood hydrograph was synthesized from the 24-hour recorded rainfall at the Wildomar station. By varying slightly the 24-hour rainfall distribution and the loss rate published in the report, the January 1969 flood hydrograph was synthesized as shown on Figure 7. Table 4 shows the values used in synthesizing the hydrograph. The amount of effective rains shown in Table 4 was determined by using either 10 percent of the rainfall or the rainfall minus 0.3 inch per hour, whichever value was larger. The effective rain was then distributed according to the S-curve distribution in the District's report.

The Murrieta Creek watershed was

then divided into subareas as shown in Figure 2 of the text and its lag time computed according to the equation shown on Figure 8.

A 24-hour rainfall frequency curve was plotted from recorded data (Table 5) at Wildomar station as shown on Figure 9. By knowing the 24-hour rainfall and using the distribution rate and effective rain shown on Table 4 and the S-curve in the District's report, flood hydrographs were developed for the subareas.

The value for the 100-year maximum 24-hour rainfall determined from the curve compares favorably with the 100-year 24-hour rainfall data for the area published by the U. S. Weather Bureau in its Technical Paper No. 40, "Rainfall Frequency Atlas of the United States."

The 24-hour rainfall was then distributed accordingly and flood hydrographs were developed for:

- a) Murrieta Creek just upstream of Warm Springs Creek;
- b) Warm Springs Creek;
- c) Santa Gertrudis Creek (including area above Auld Valley Dam); and
- d) Area above Auld Valley Dam.

These hydrographs were then combined to determine the peak discharges at points of major tributaries. The inflow hydrograph to Lake Skinner (Auld Valley Dam) was routed with the outflow hydrograph as shown on Figure 10. Lake Skinner, which serves as a water supply and regulatory reservoir, is assumed to be operated under full reservoir conditions. Therefore, no flood storage capacity was assumed available at the beginning

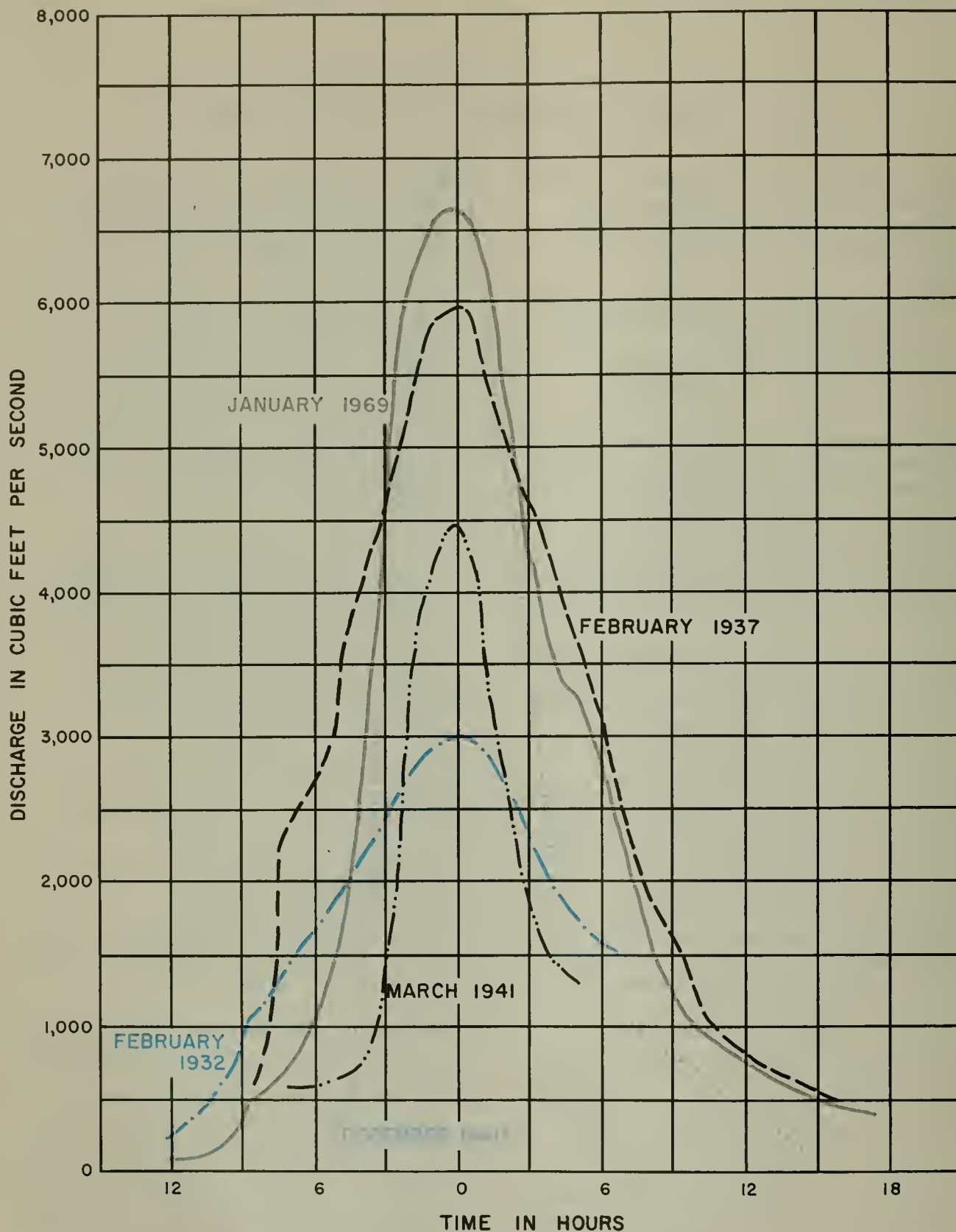


Figure 6—FLOOD HYDROGRAPHS OF RECORD,
"MURRIETA CREEK AT TEMECULA"

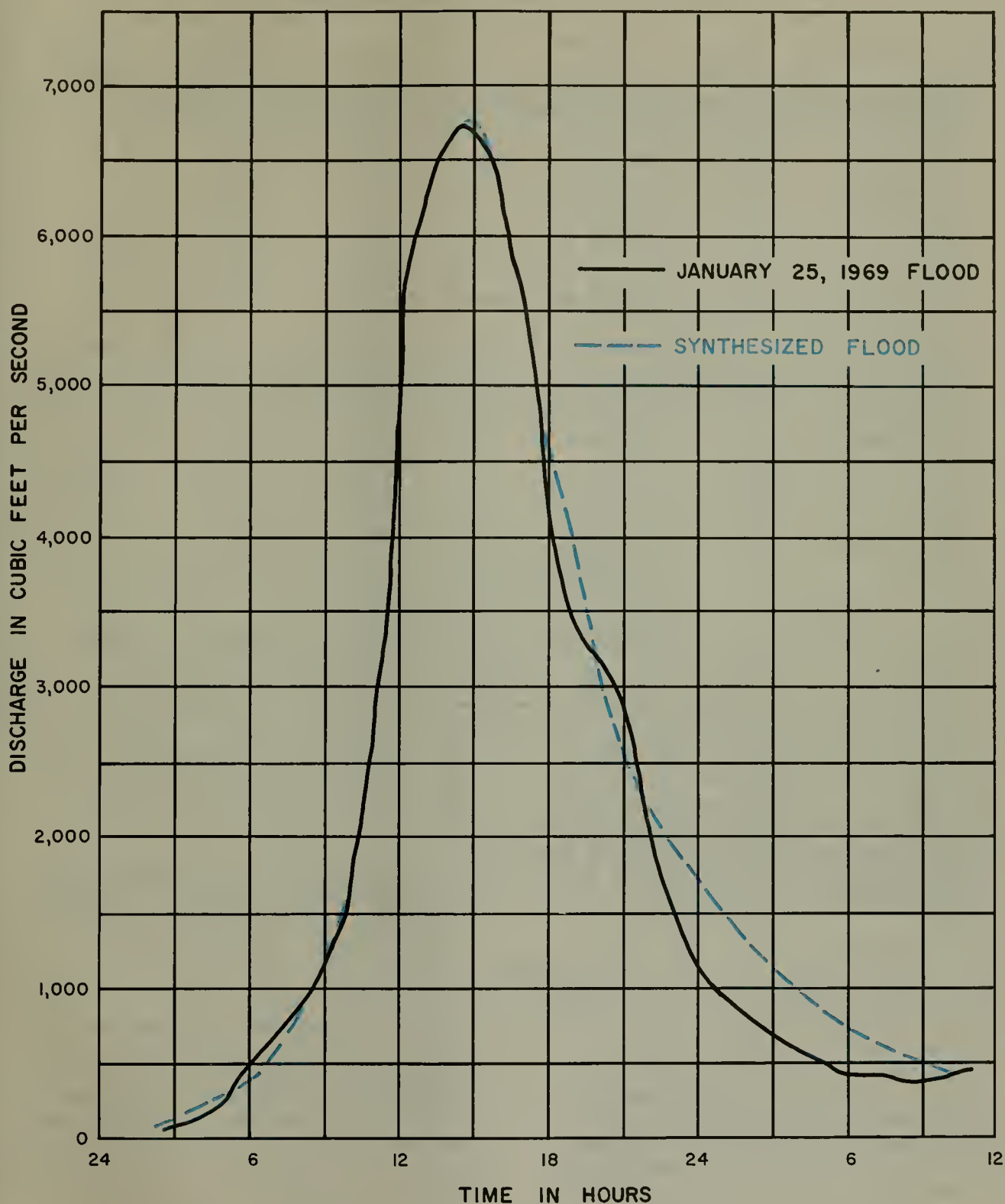


Figure 7— COMPARISON OF SYNTHETIC HYDROGRAPH
WITH JANUARY 1969 FLOOD HYDROGRAPH

TABLE 4 - 24-HOUR RAINFALL DISTRIBUTION

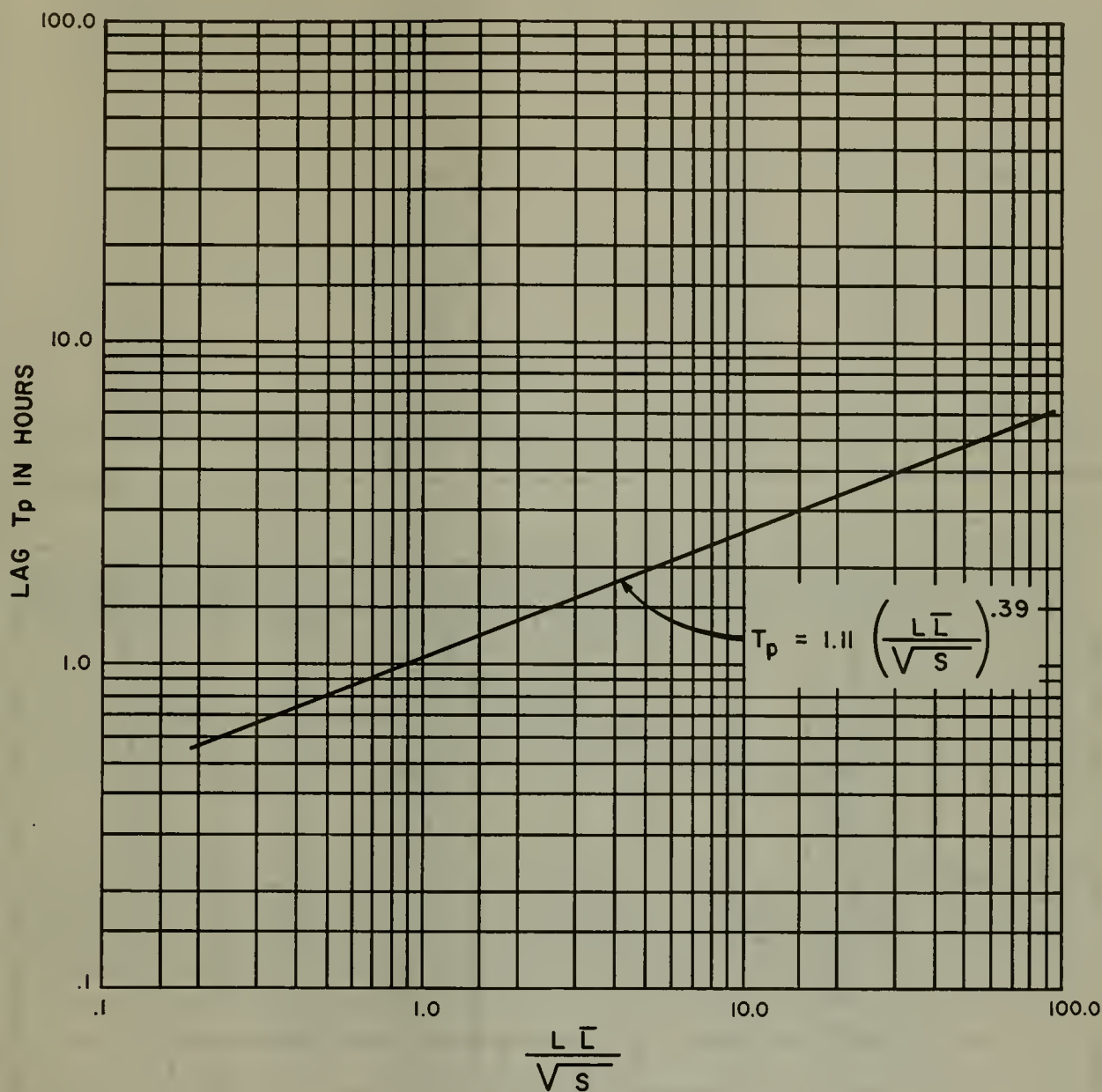
<i>Unit Time</i>	<i>Distribution %</i>	<i>Rainfall Inch/Hour</i>	<i>Effective Rainfall Inch/Hour</i>	<i>Unit Time</i>	<i>Distribution %</i>	<i>Rainfall Inch/Hour</i>	<i>Effective Rainfall Inch/Hour</i>
1	0.5	.035	.003	13	9.5	.656	.356
2	0.5	.035	.003	14	8.8	.607	.307
3	1.1	.076	.007	15	8.8	.607	.307
4	1.4	.097	.009	16	8.2	.566	.266
5	2.0	.138	.013	17	7.2	.497	.197
6	2.2	.152	.015	18	0.8	.055	.005
7	4.9	.338	.038	19	0.4	.028	.002
8	5.7	.393	.093	20	0.4	.028	.002
9	8.2	.566	.266	21	0.3	.021	.002
10	8.0	.552	.252	22	0.3	.021	.002
11	9.9	.683	.383	23	0.2	.014	.001
12	10.5	.725	.425	24	0.2	.014	.001

of the storm. However, surcharge storage reduces the peak outflow from the lake. The refinement of channel routing was omitted throughout as this latter refinement would not change the results significantly because of the relatively short travel time.

Further analyses of the two major tributaries, Santa Gertrudis Creek and Warm Springs Creek indicated that the creeks were not capable of carrying the computed peak discharges without substantial overflow in the lower reaches. The 100-year frequency floods are well contained within the channel upstream of the Highway 395 crossing. At a point immediately downstream of Highway 395 the flood flows break out of the banks, and the overflows would be sheet flows that reenter Murrieta Creek downstream of their respective confluences.

The estimated in-channel capacities are 1,300 cfs for Warm Springs Creek and 1,400 cfs for Santa Gertrudis Creek.

In order to check the reasonableness of these peak discharges, a discharge frequency curve was developed for gaging station "Murrieta Creek at Temecula" from record (see Table 6). Plot of the curve is shown in Figure 11. Extrapolation of the curve shows a once-in-a-hundred year discharge of about 29,000 cfs which compares favorably with the 30,900 cfs computed for this study and with the District's unpublished study "Hydrology Report for Temecula and Murrieta Creeks and their Tributaries" and the U. S. Corps of Engineers' "Report on the Hydrology of the Santa Margarita River and Tributaries" of March 15 1949.



T_p = BASIN LAG IN HOURS

L = BASIN LENGTH

\bar{L} = LENGTH TO CENTER OF AREA

S = BASIN SLOPE

REFERENCE: APPLIED HYDROLOGY BY
LINSLEY, KOHLER AND PAULHUS

Figure 8—BASIN LAG RELATIONSHIP CURVE FOR THE
MURRIETA CREEK WATERSHED

TABLE 5 - 24 HOURS PRECIPITATION DATA
FOR WILDOMAR STATION

<i>Year</i>	<i>Rainfall (inches)</i>	<i>Year</i>	<i>Rainfall (inches)</i>
1967	3.06	1946	3.15
1966	4.07	1945	2.01
1964	1.45	1943	6.90
1962	2.28	1938	6.67
1961	1.14	1928	1.95
1958	3.45	1927	6.66
1950	1.10	1926	2.55
1949	1.55	1922	4.18

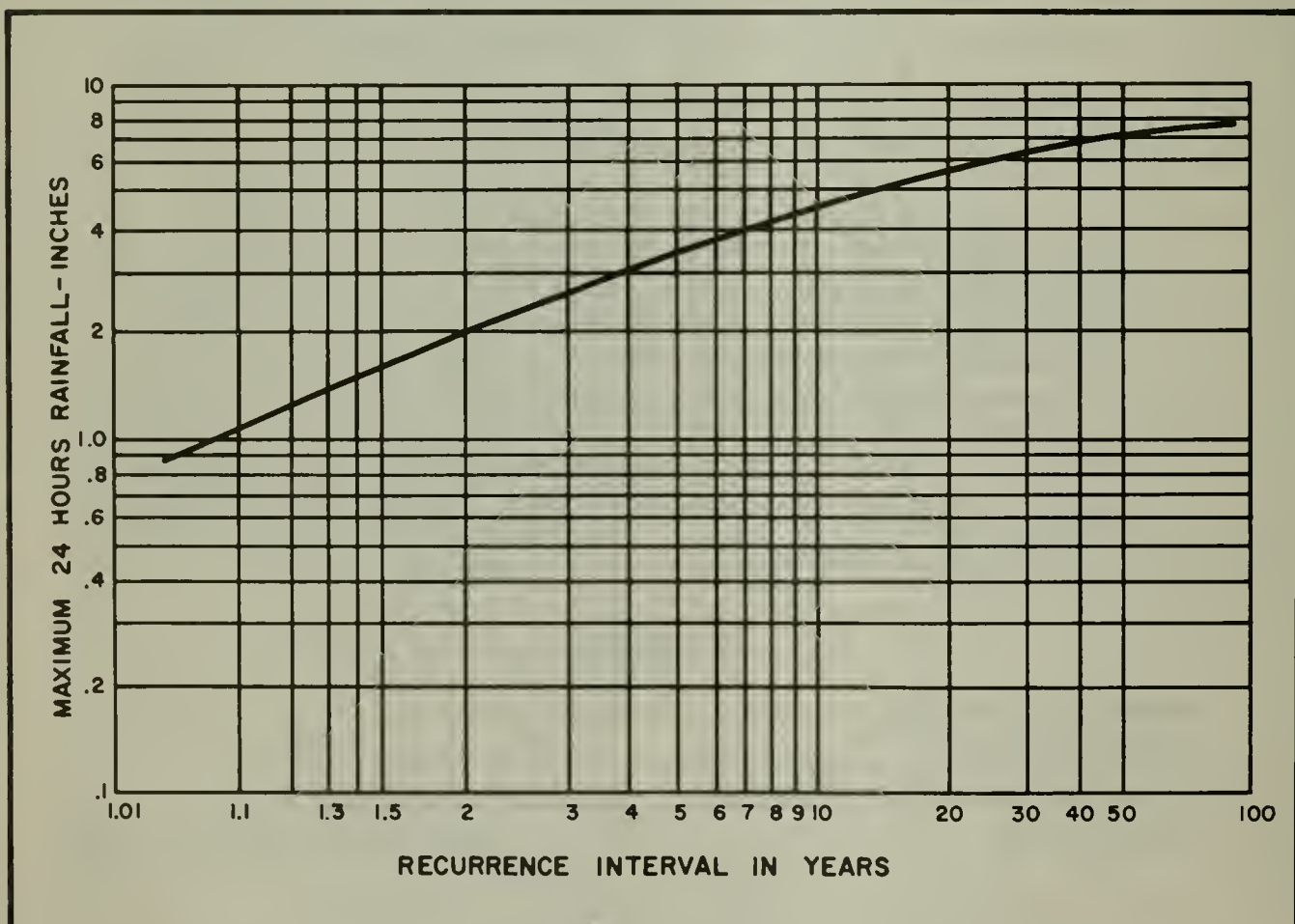


Figure 9 - 24-HOUR RAINFALL FREQUENCY CURVE
AT WILDOMAR STATION (T7S, R4W, SEC.3)

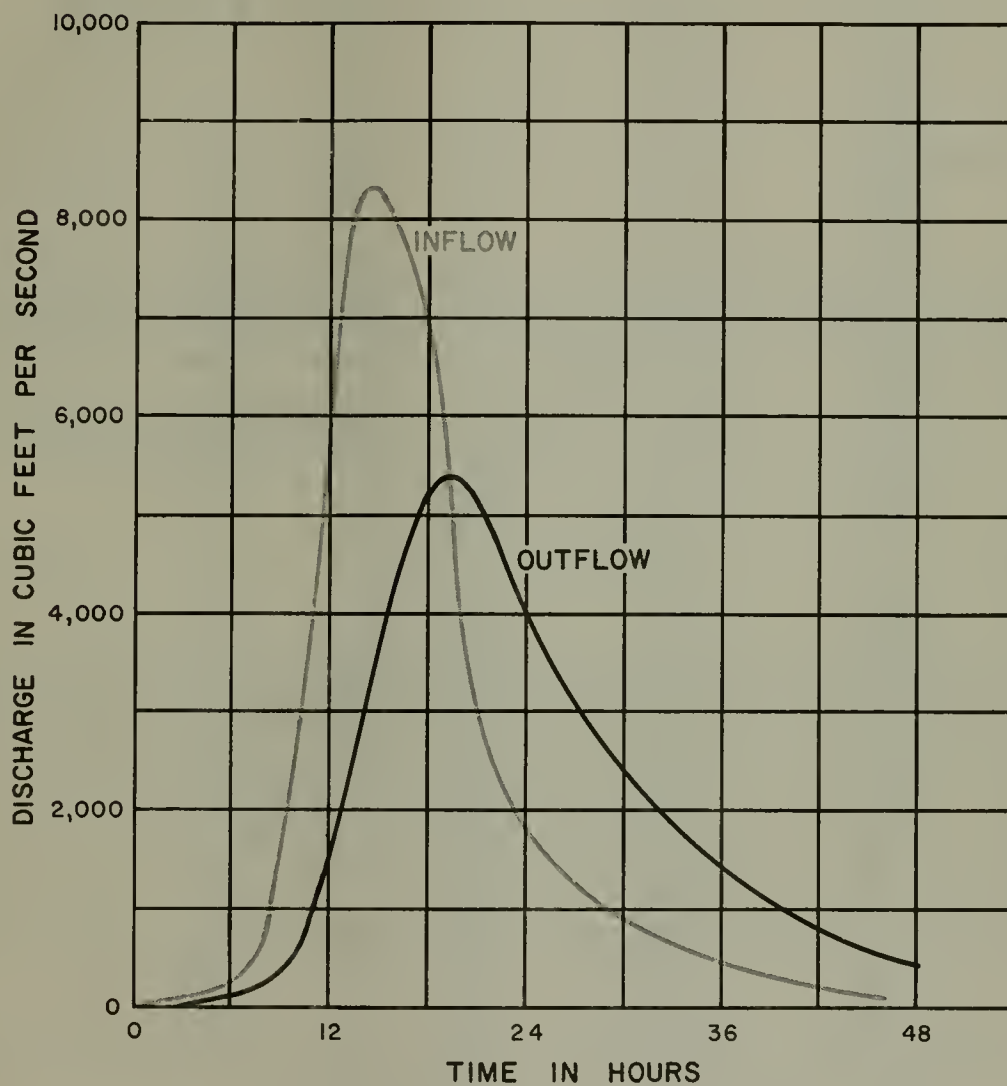


Figure 10—INFLOW-OUTFLOW HYDROGRAPH, LAKE SKINNER,
100-YEAR-FREQUENCY FLOOD (FULL RESERVOIR)

TABLE 6
FLOOD DATA FOR GAGING STATION-MURRIETA CREEK AT TEMECULA

Water year	Discharge,* in cfs	Annual floods		Stations used for correlation purposes
		Order (M)	Recurrence interval in years	
(1)	(2)	(3)	(4)	(5)
1906	(8,500)	7	9.71	Sweetwater River near Descanso
07	(920)	31	2.19	Sweetwater River near Descanso
08	(410)	43	1.58	Sweetwater River near Descanso
09	(2,400)	19	3.58	Sweetwater River near Descanso
10	(2,700)	17	4.0	Sweetwater River near Descanso
11	(760)	34	2.0	Sweetwater River near Descanso
12	(1,900)	23	2.96	Sweetwater River near Descanso
13	(840)	32	2.13	Sweetwater River near Descanso
14	(1,300)	29	2.34	Santa Ysabel Creek at Sutherland Dam
15	(1,500)	28	2.43	Santa Ysabel Creek at Sutherland Dam
1916	23,300	1	68.0	
17	(760)	33	2.06	Santa Ysabel Creek at Sutherland Dam
18	(2,000)	22	3.09	Santa Ysabel Creek at Sutherland Dam
19	(300)	45	1.51	Santa Ysabel Creek at Sutherland Dam
20	(1,200)	30	2.27	Santa Ysabel Creek at Sutherland Dam
21	(110)	54	1.26	Santa Ysabel Creek at Sutherland Dam
22	(6,300)	10	6.80	Santa Ysabel Creek at Sutherland Dam
23	(470)	40	1.70	Santa Ysabel Creek at Sutherland Dam
24	(78)	55	1.24	Santa Ysabel Creek at Sutherland Dam
25	(48)	58	1.17	Santa Ysabel Creek at Sutherland Dam
1926	(1,800)	24	2.83	Santa Ysabel Creek at Sutherland Dam
27	16,000	4	17.0	
28	(42)	62	1.10	Santa Margarita River near Temecula
29	(140)	51	1.33	Santa Margarita River near Temecula
30	(1,500)	27	2.52	Santa Margarita River near Temecula
31	340	44	1.55	
32	5,100	13	5.23	
33	274	48	1.42	
34	23	63	1.08	
35	228	50	1.36	
1936	2,580	18	3.78	
37	5,870	11	6.18	
38	16,800	3	22.67	
39	731	35	1.94	
40	7,550	8	8.50	
41	7,140	9	7.56	
42	54	57	1.19	
43	17,500	2	34.0	
44	4,000	15	4.53	
45	1,600	25	2.72	
1946	650	36	1.89	
47	125	52	1.31	
48	57	56	1.22	
49	12	65	1.05	
50	4	66	1.03	
51	15	64	1.06	
52	9,140	6	11.33	
53	530	38	1.79	
54	2,100	21	3.24	
55	502	39	1.74	
1956	116	53	1.28	
57	438	41	1.66	
58	5,740	12	5.67	
59	280	47	1.45	
60	44	60	1.13	
61	0	67	1.01	
62	410	42	1.62	
63	3,700	16	4.25	
64	42	61	1.11	
65	555	37	1.84	
1966	5,020	14	4.86	
67	1,510	26	2.62	
68	46	59	1.15	
69	10,400	5	13.6	
70	2,200	20	3.4	
71	283	46	1.48	
72	232	49	1.39	

*Discharge values shown in parentheses are synthetic values derived by correlation between stations shown in Column 5.

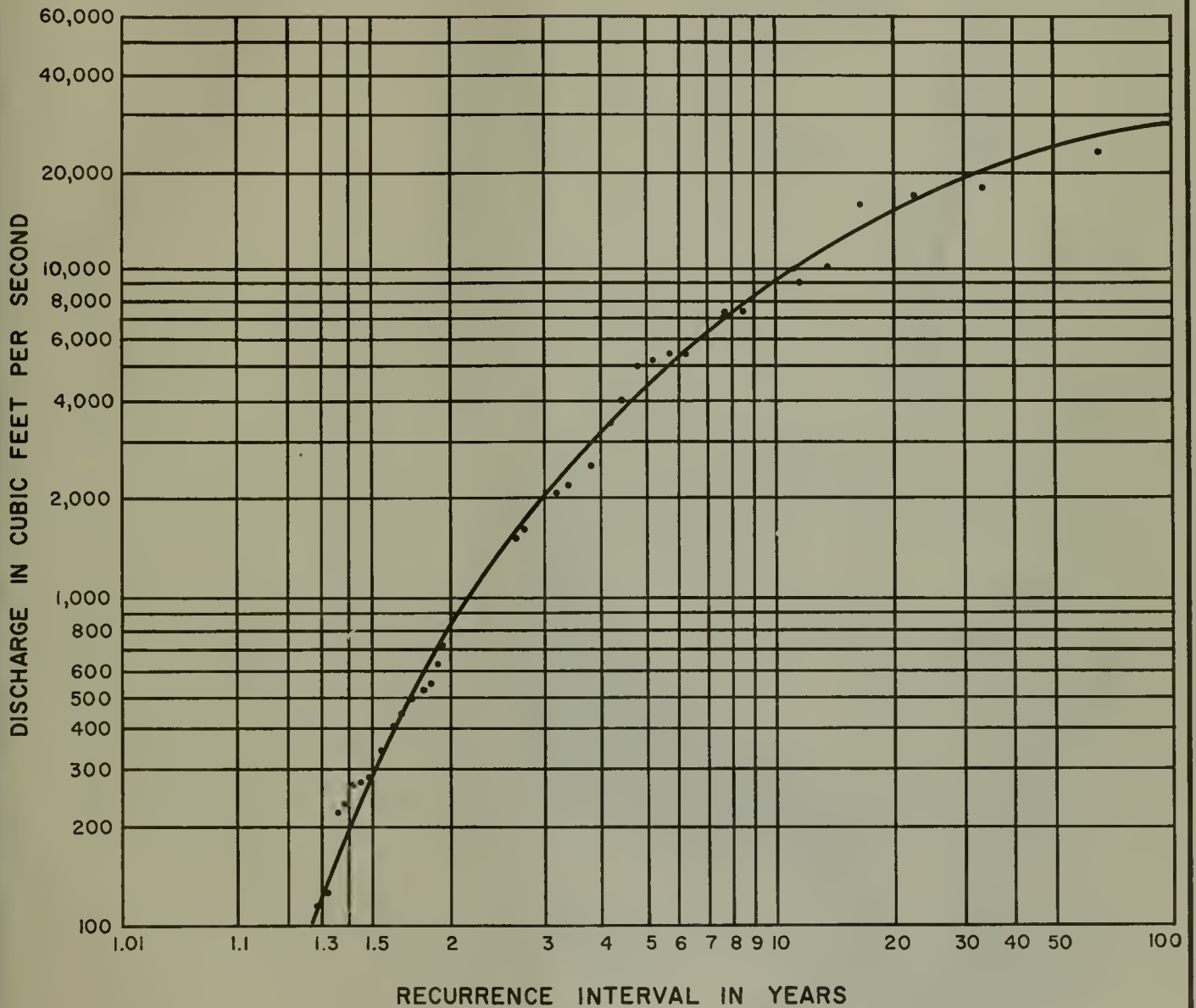


Figure II—DISCHARGE—FREQUENCY CURVE
"MURRIETA CREEK AT TEMECULA"



SOURCES

ATIONS

NUNDATION
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SANTA MARGARITA RIVER
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E-1,720,000

800

LEGEND

INUNDATED AREA FOR
100-YEAR FLOOD

GAGING STATION MURRIETA CREEK
AT TEMECULA

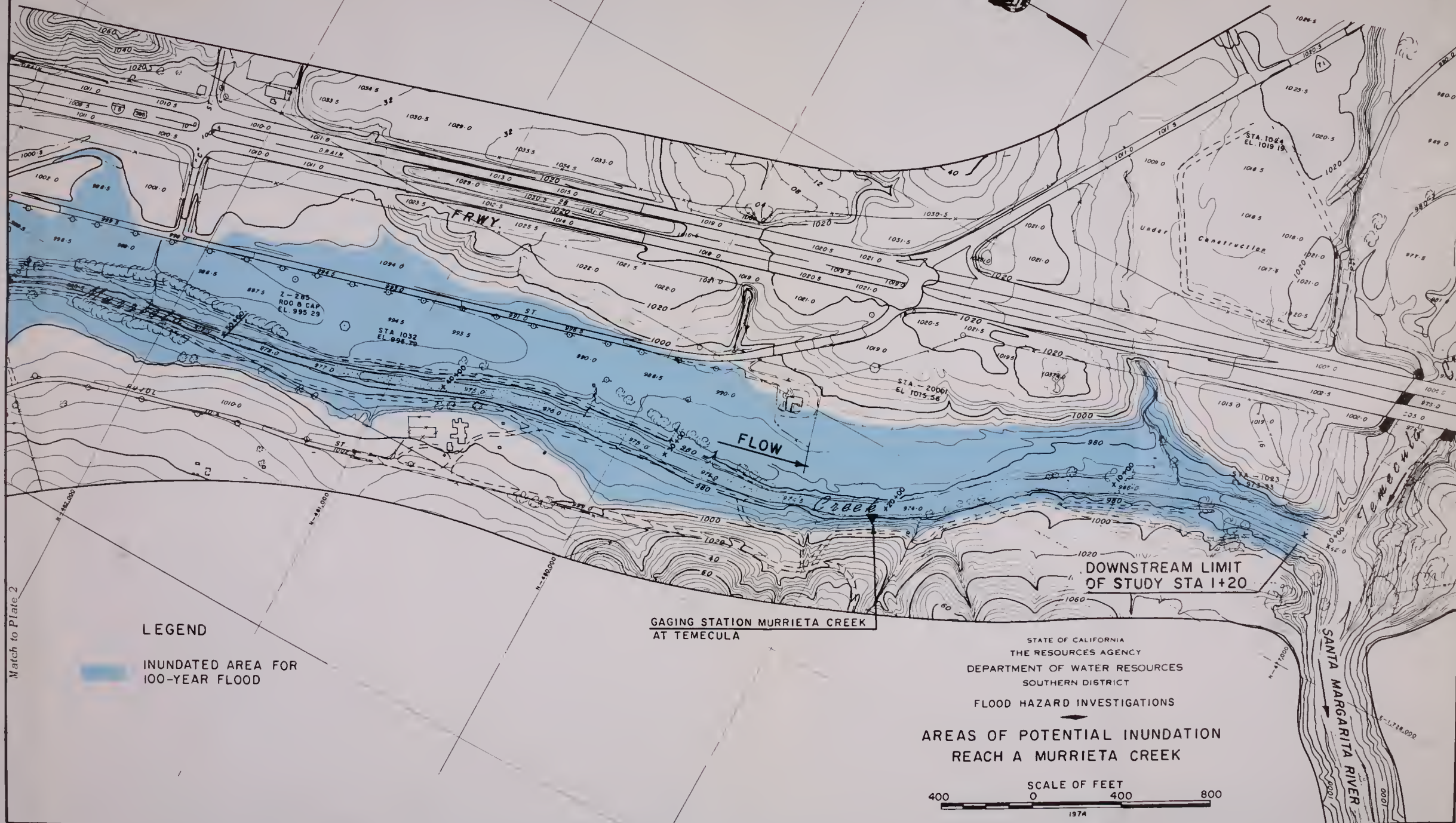
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AREAS OF POTENTIAL INUNDATION
REACH A MURRIETA CREEK

SCALE OF FEET

400 0 400 800

1974

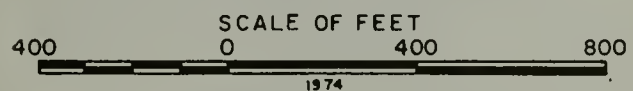


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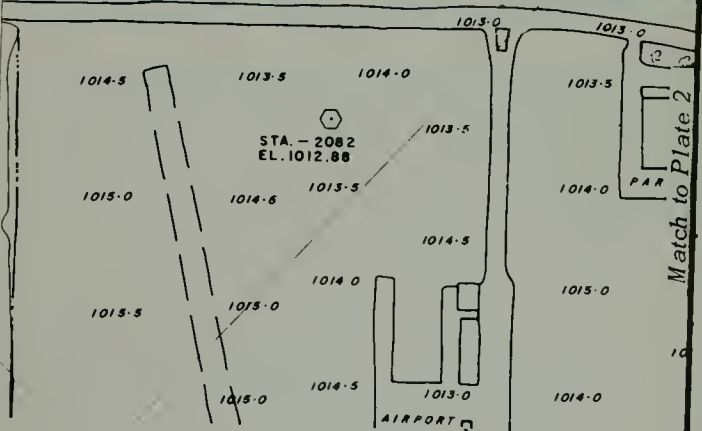


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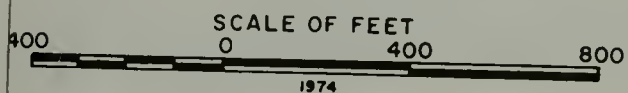




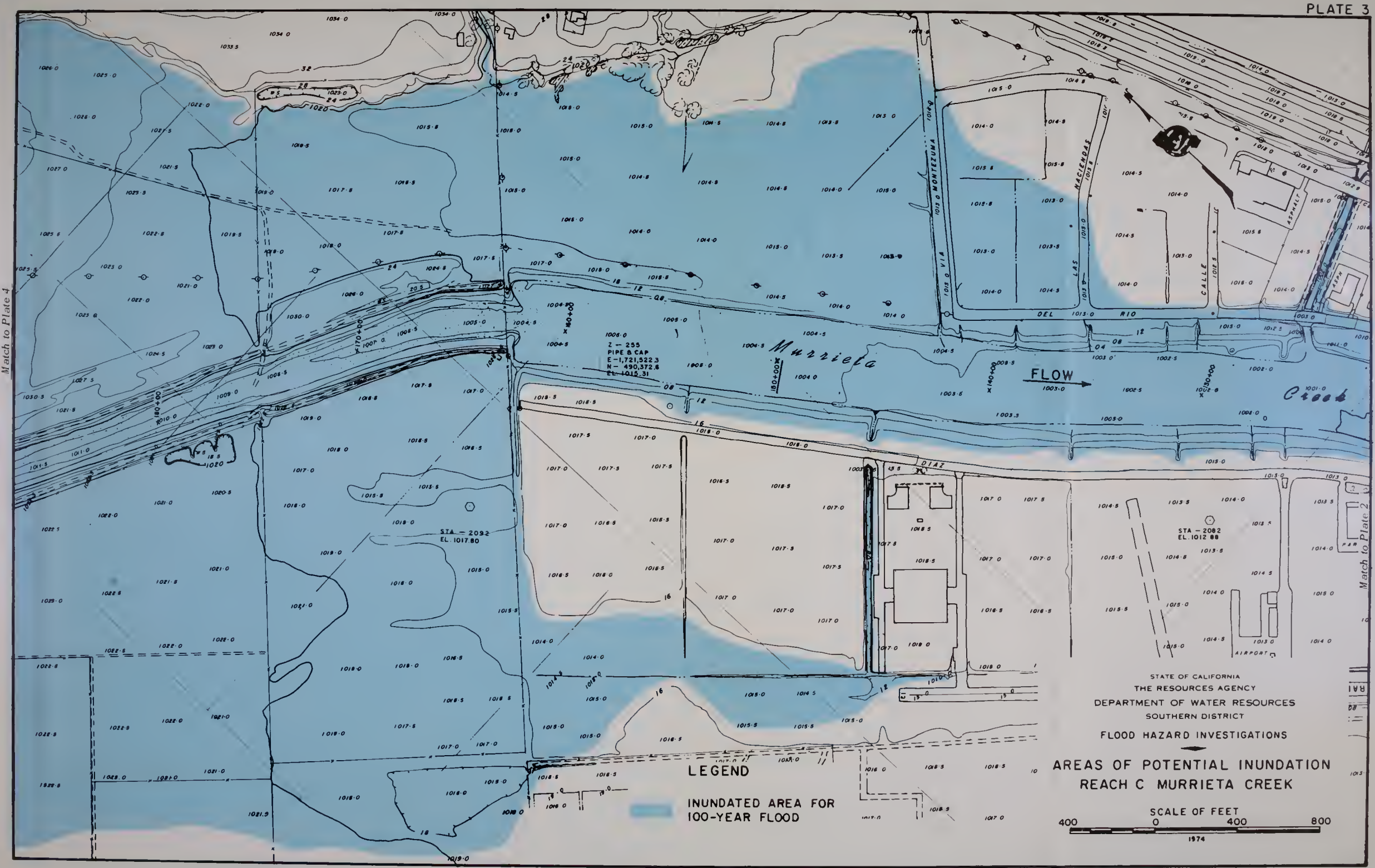


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REACH C MURRIETA CREEK



Match to Plate 4



Match to Plate 2

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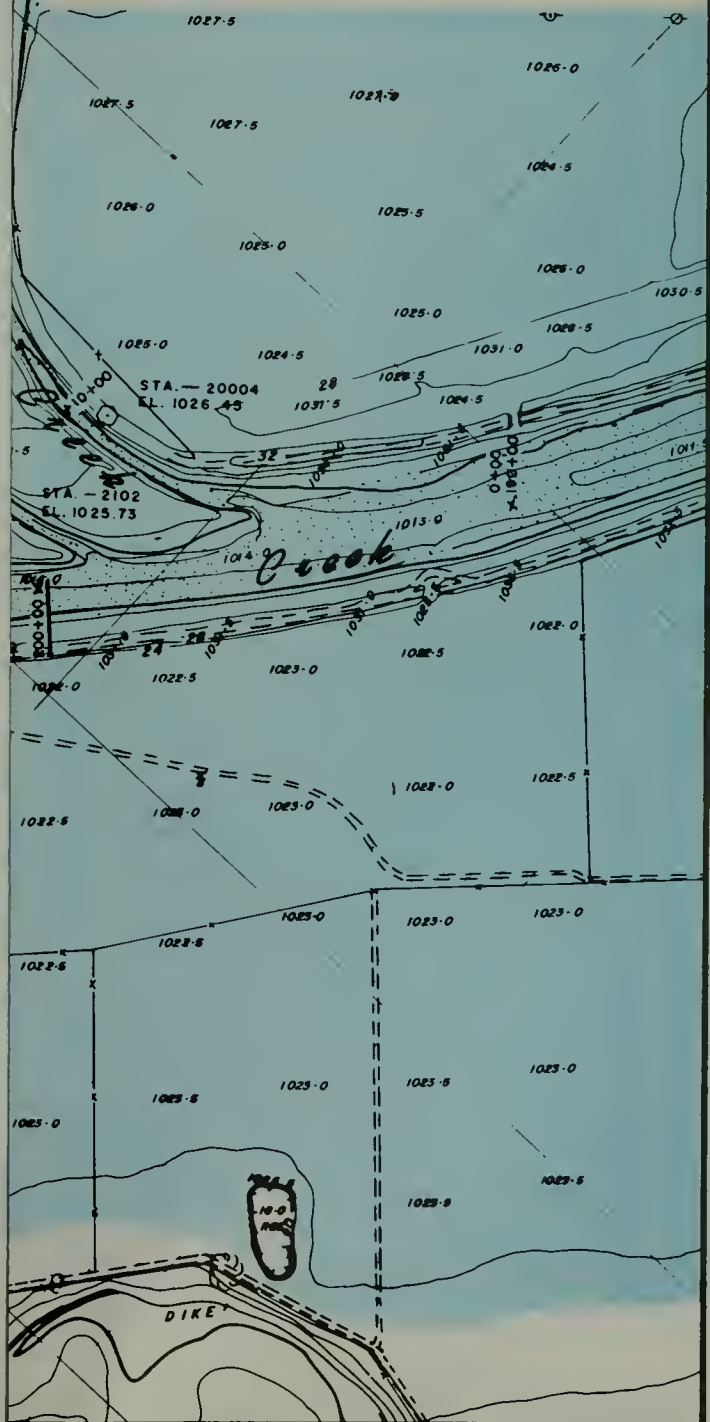
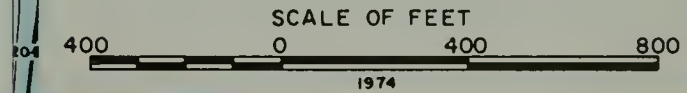
AREAS OF POTENTIAL INUNDATION
REACH C MURRIETA CREEK

LEGEND
INUNDATED AREA FOR
100-YEAR FLOOD

SCALE OF FEET
0 400 800
1974

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AREAS OF POTENTIAL INUNDATION
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SANTA GERTRUDIS CREEK AND
WARM SPRINGS CREEK



Match to Plate 3

LEGEND

INUNDATED AREA FOR
100-YEAR FLOOD

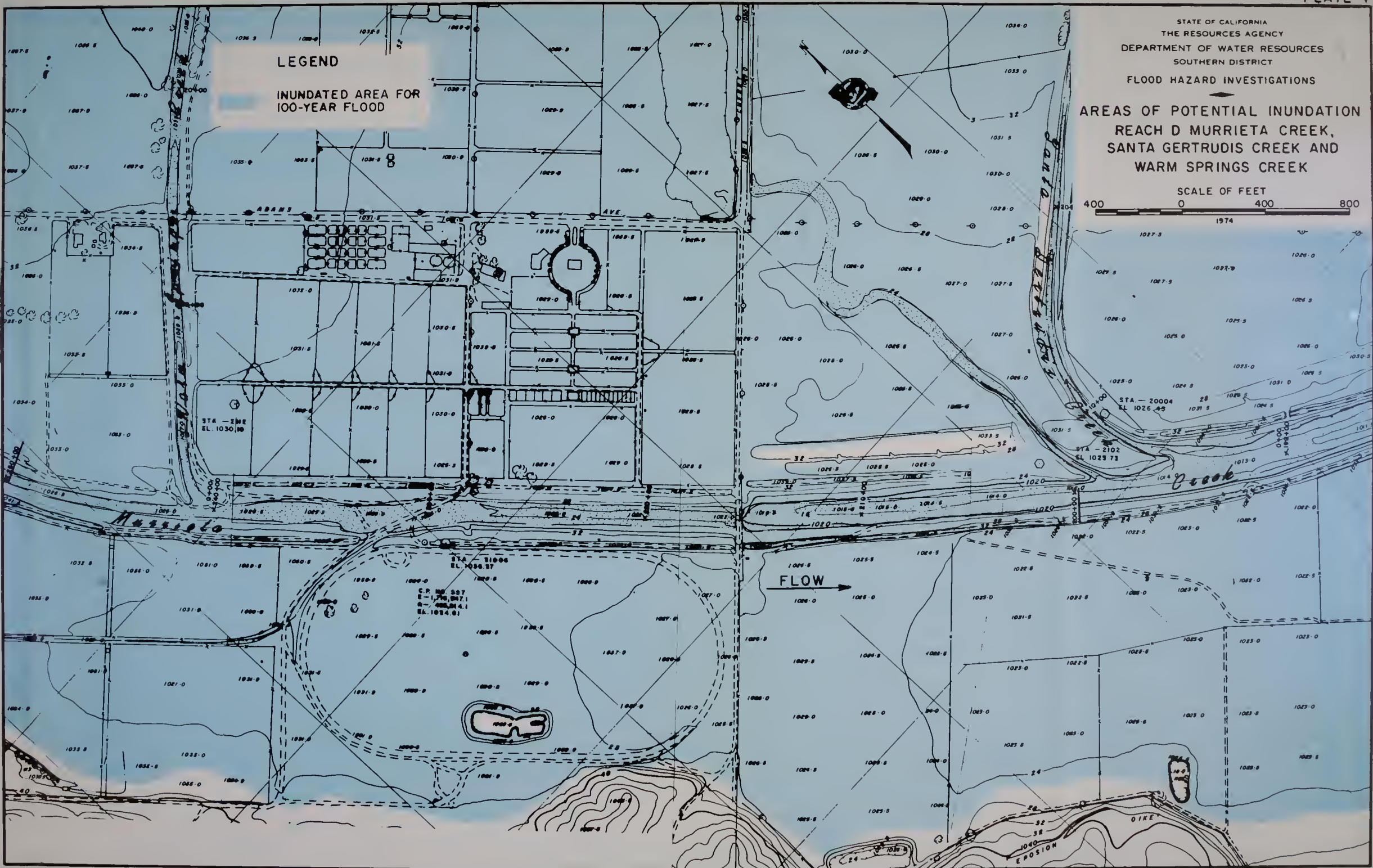
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AREAS OF POTENTIAL INUNDATION
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SANTA GERTRUDIS CREEK AND
WARM SPRINGS CREEK

SCALE OF FEET
400 0 400 800

Match to Plate 6

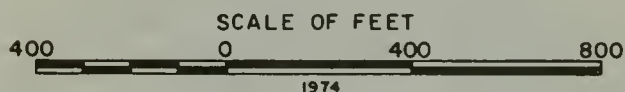


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AREAS OF POTENTIAL INUNDATION
REACH E MURRIETA CREEK,
SANTA GERTRUDIS CREEK AND
WARM SPRINGS CREEK



Match to Plate 3

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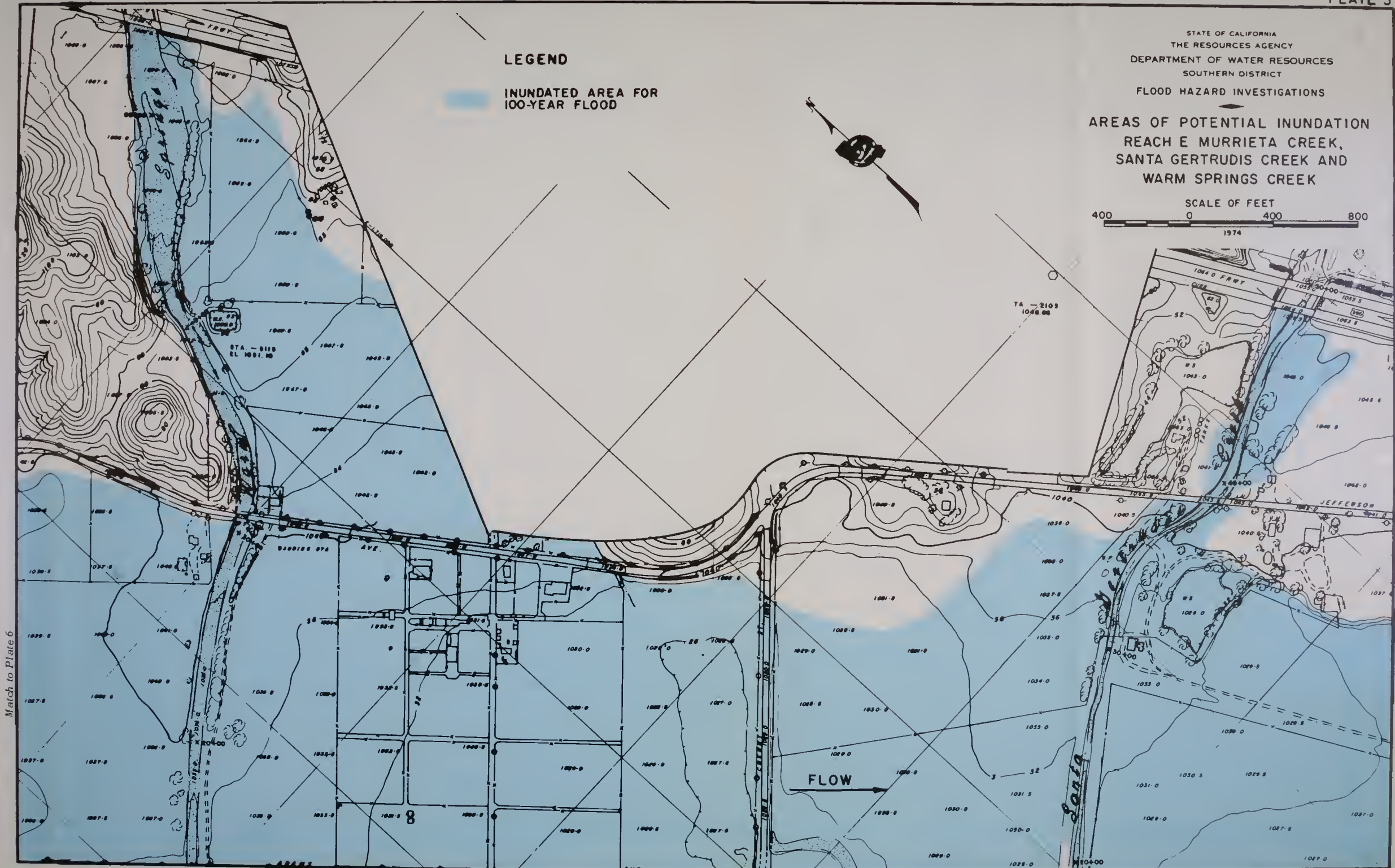
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SANTA GERTRUDIS CREEK AND
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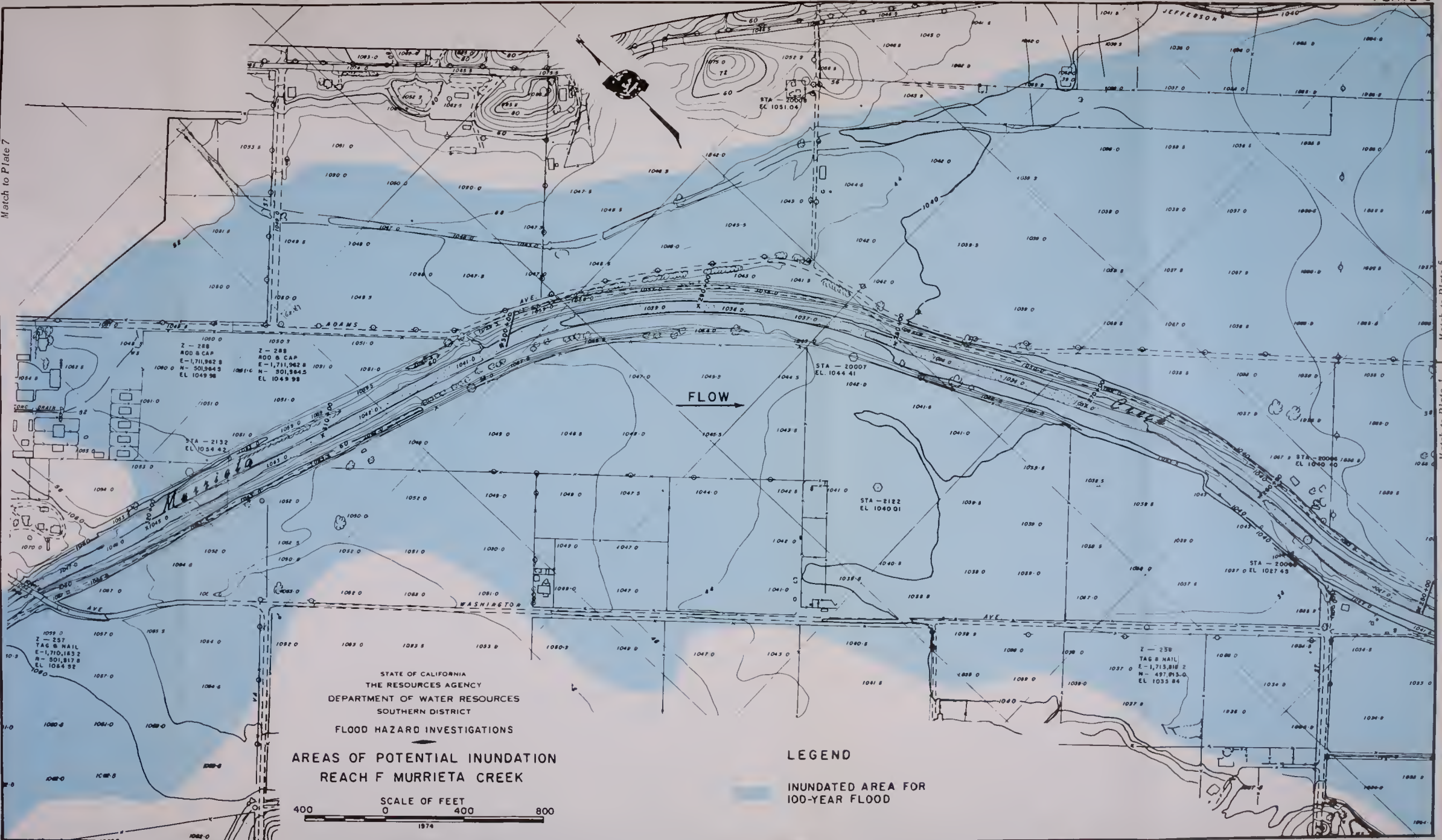
LEGEND

INUNDATED AREA FOR
100-YEAR FLOOD



SCALE OF FEET
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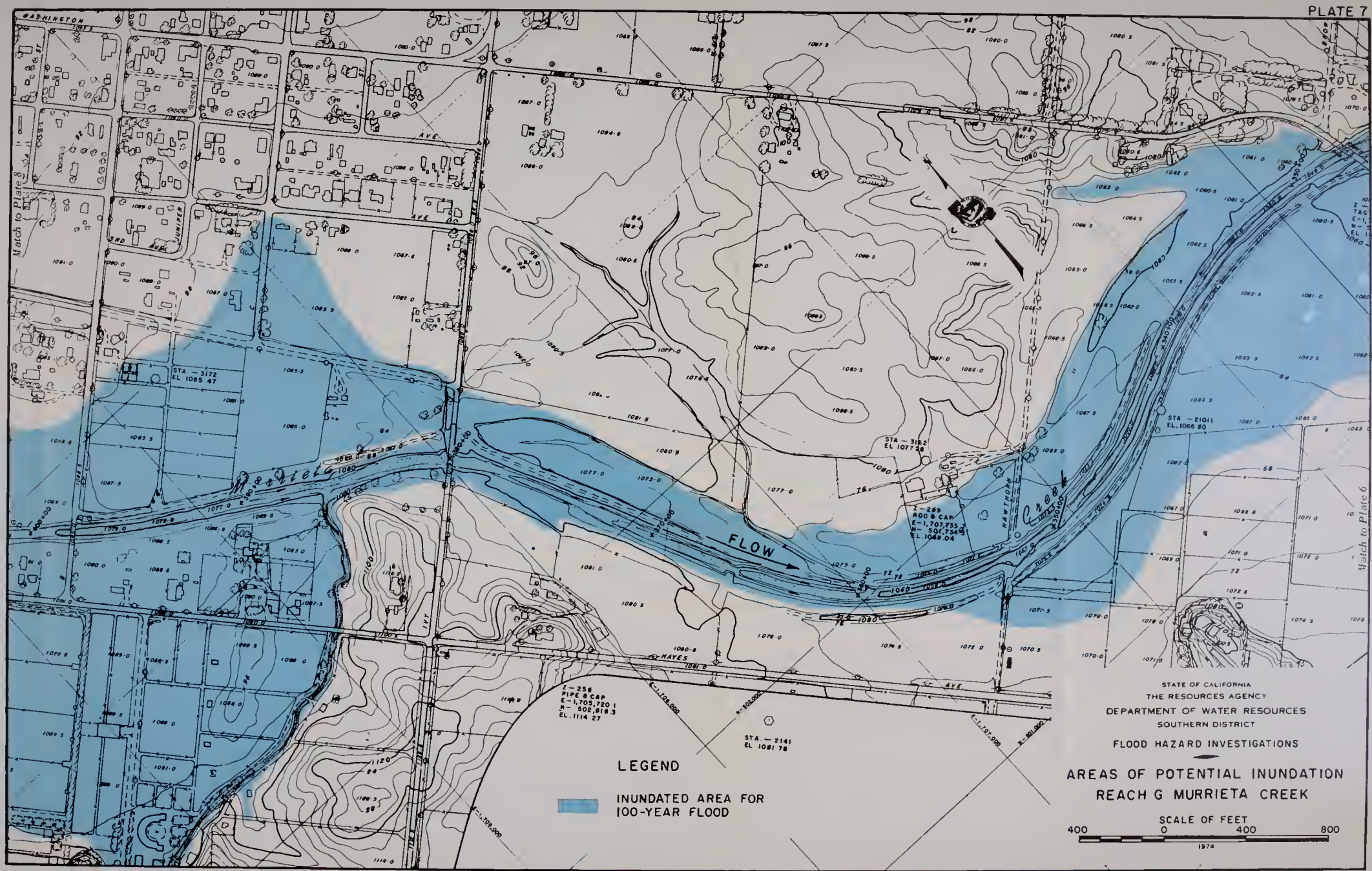
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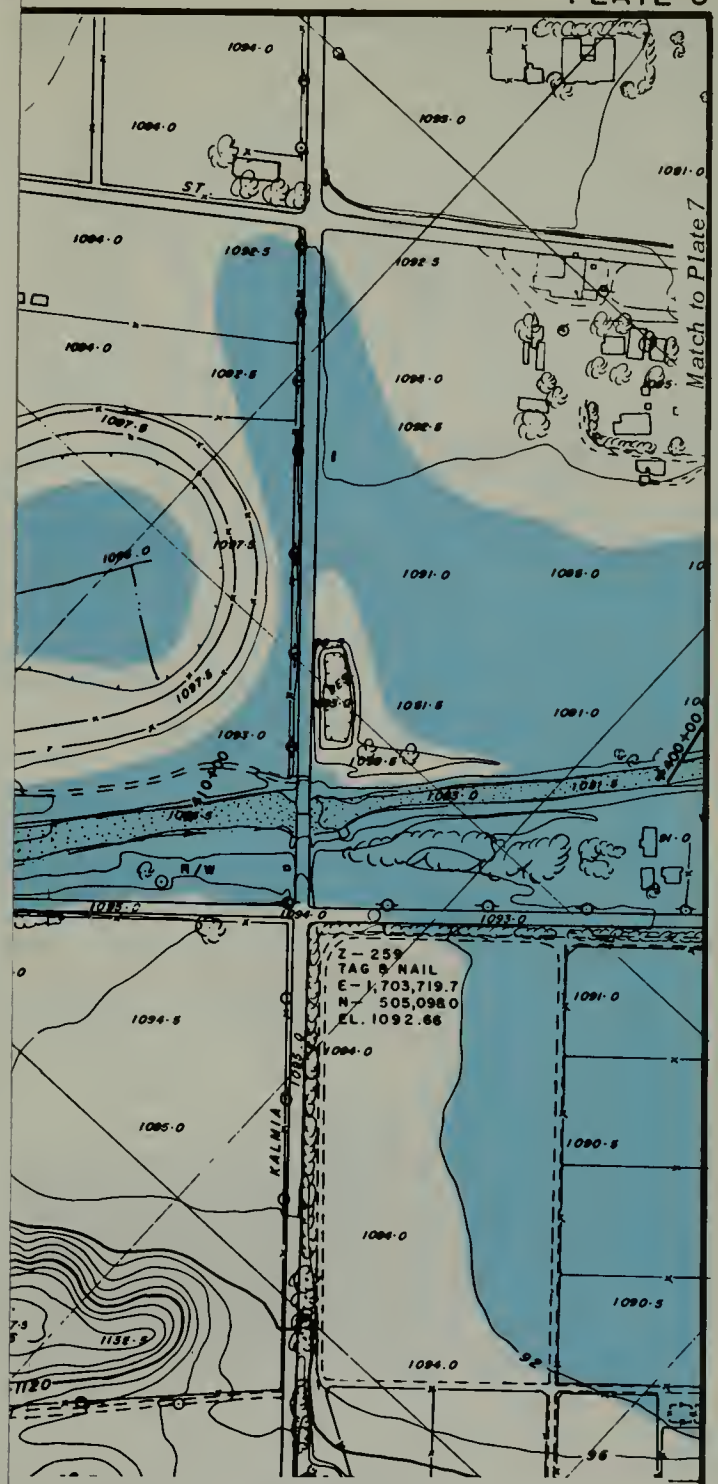
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1974

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AREAS OF POTENTIAL INUNDATION
REACH G MURRIETA CREEK

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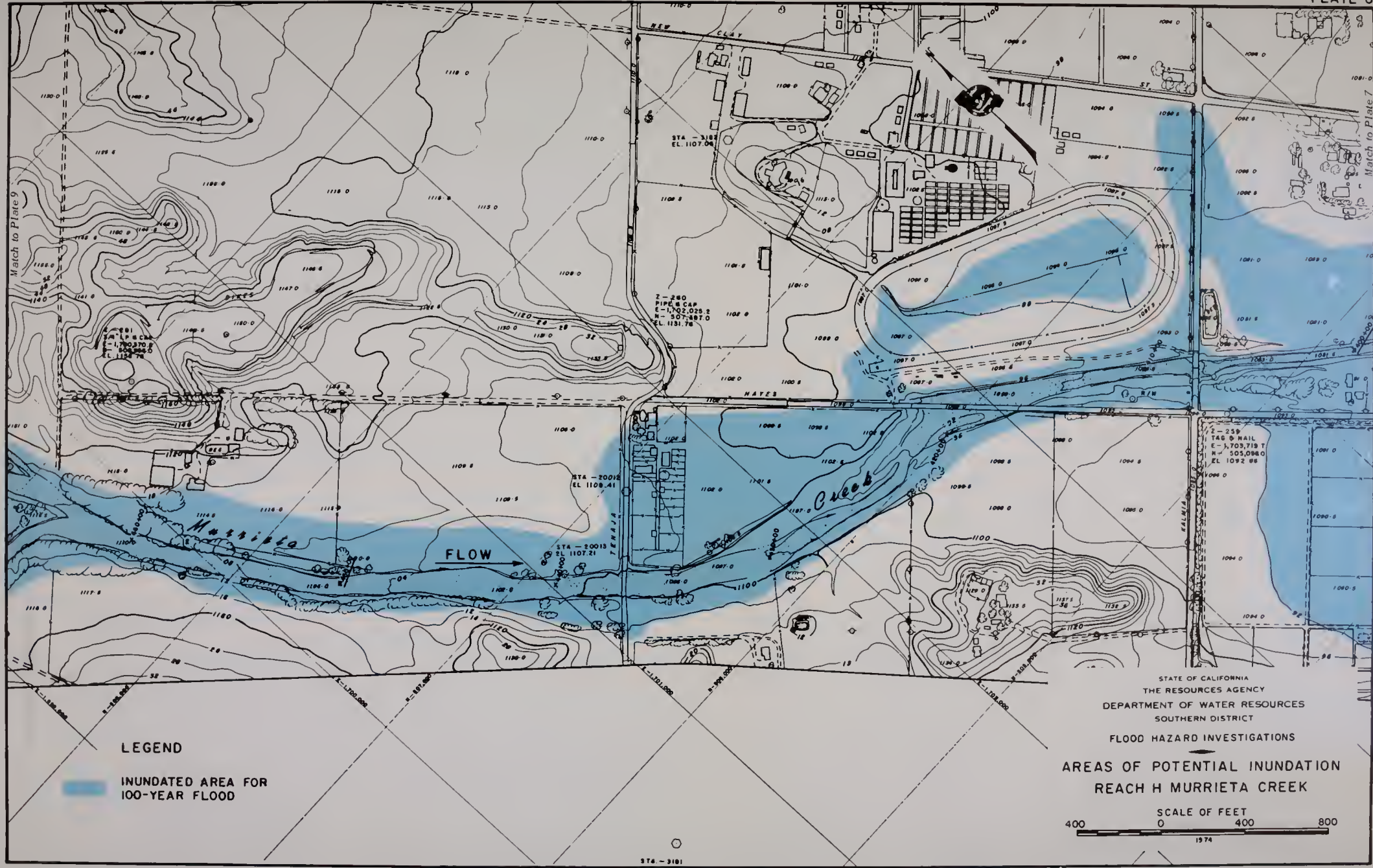
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REACH H MURRIETA CREEK

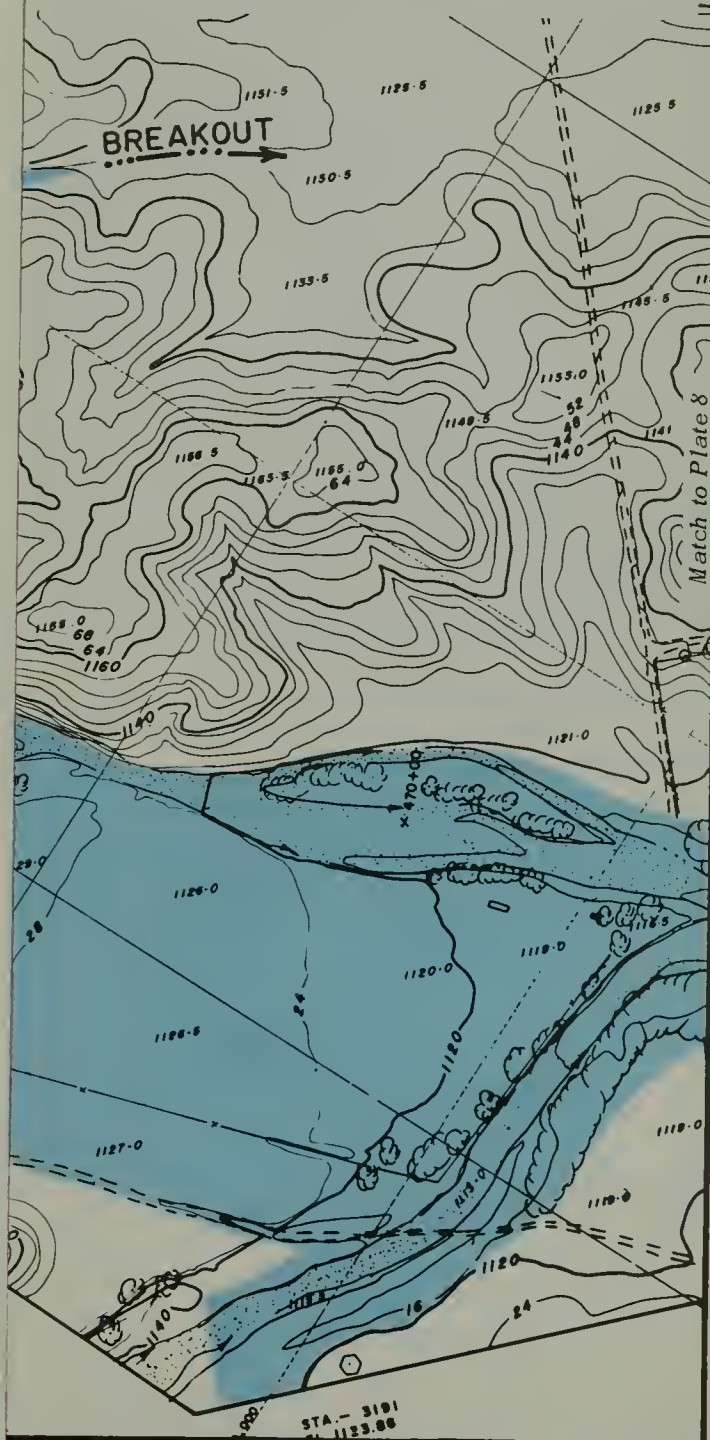




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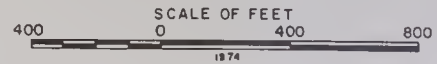
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REACH I MURRIETA CREEK

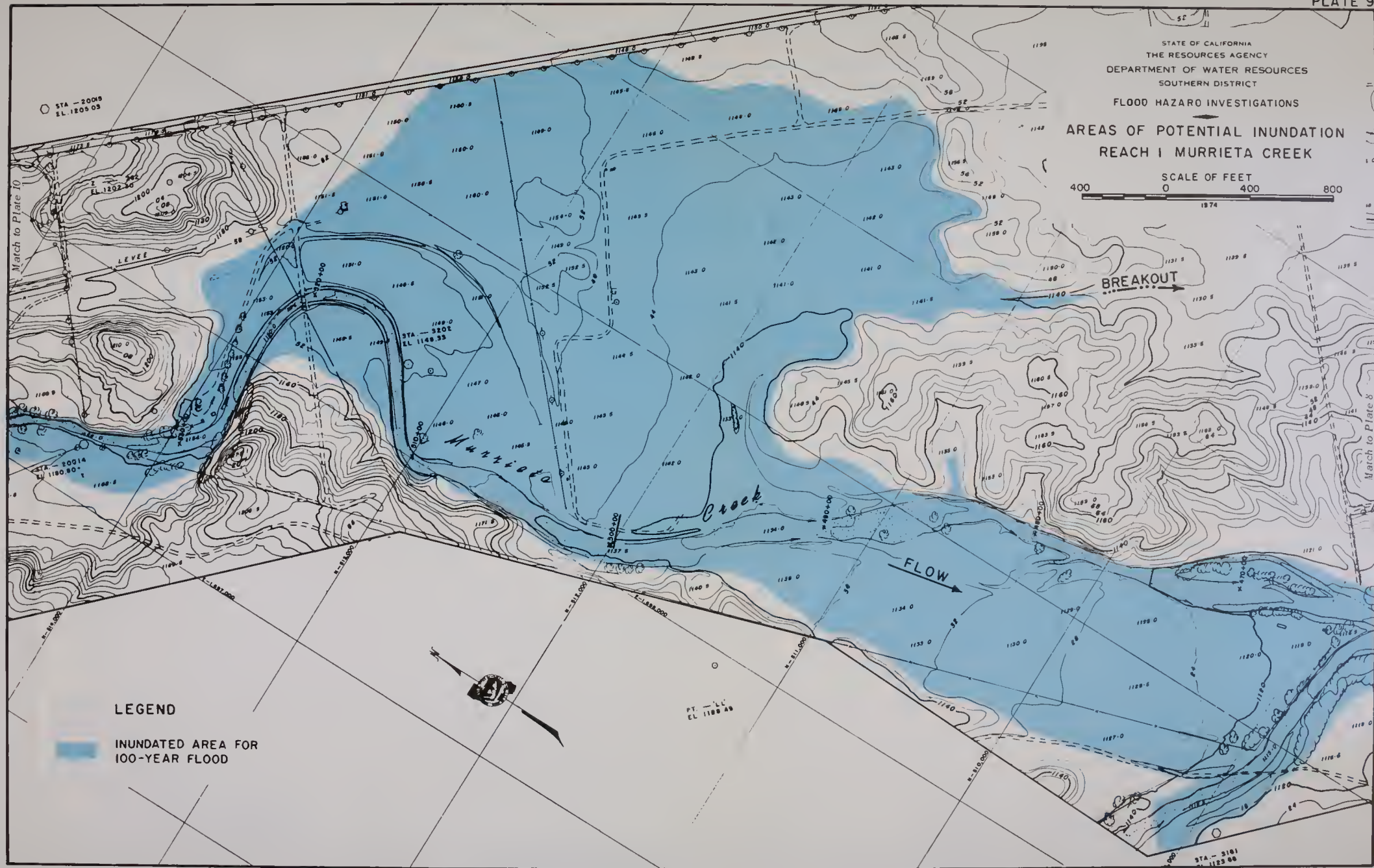


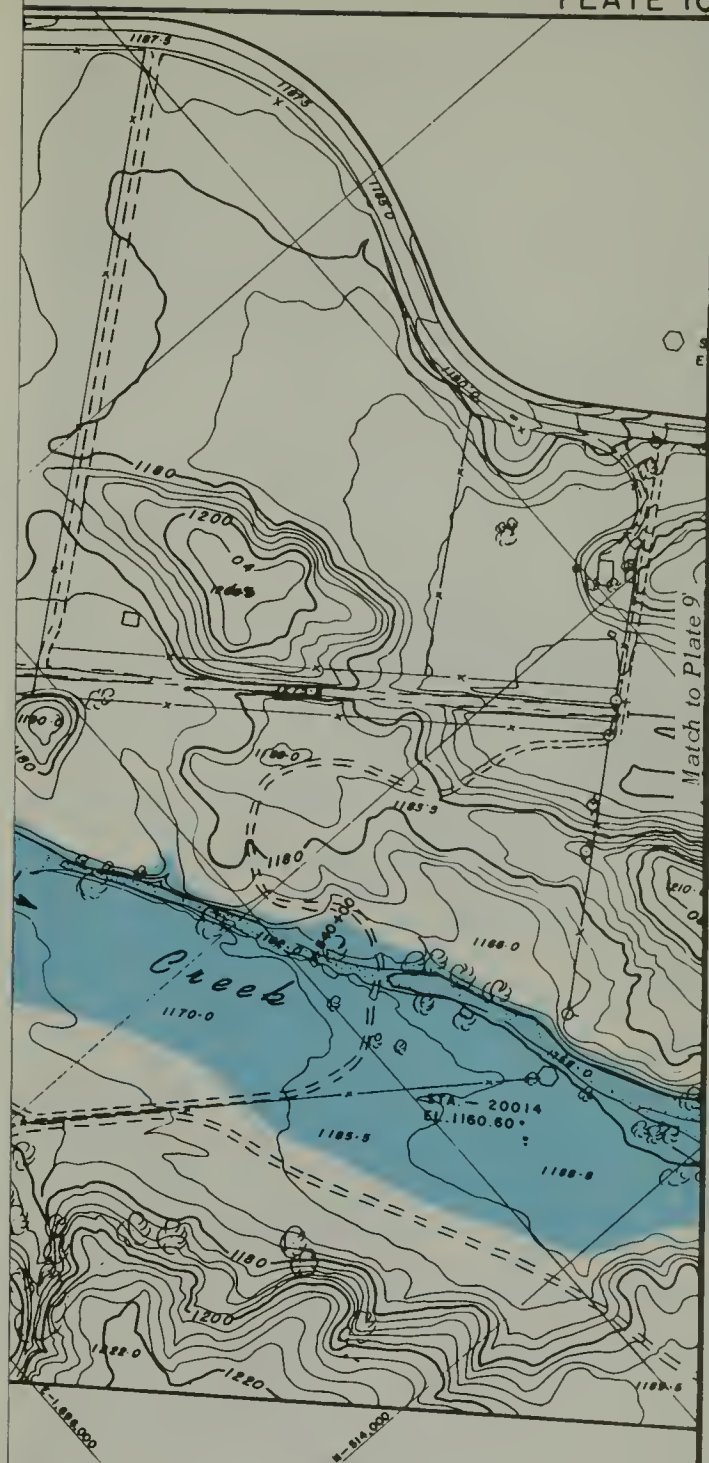
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FLOW

LEGEND

INUNDATED AREA FOR
100-YEAR FLOOD





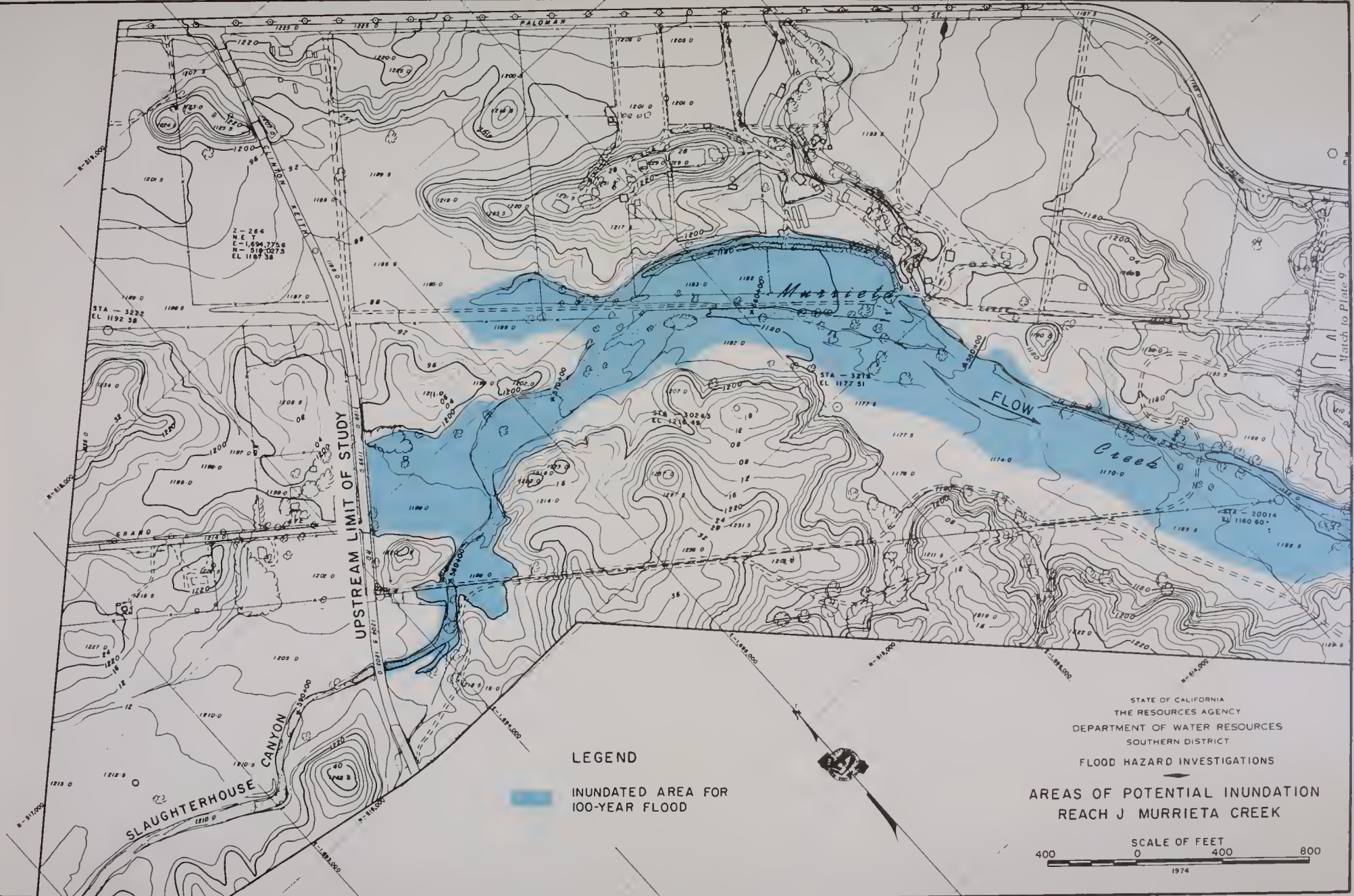
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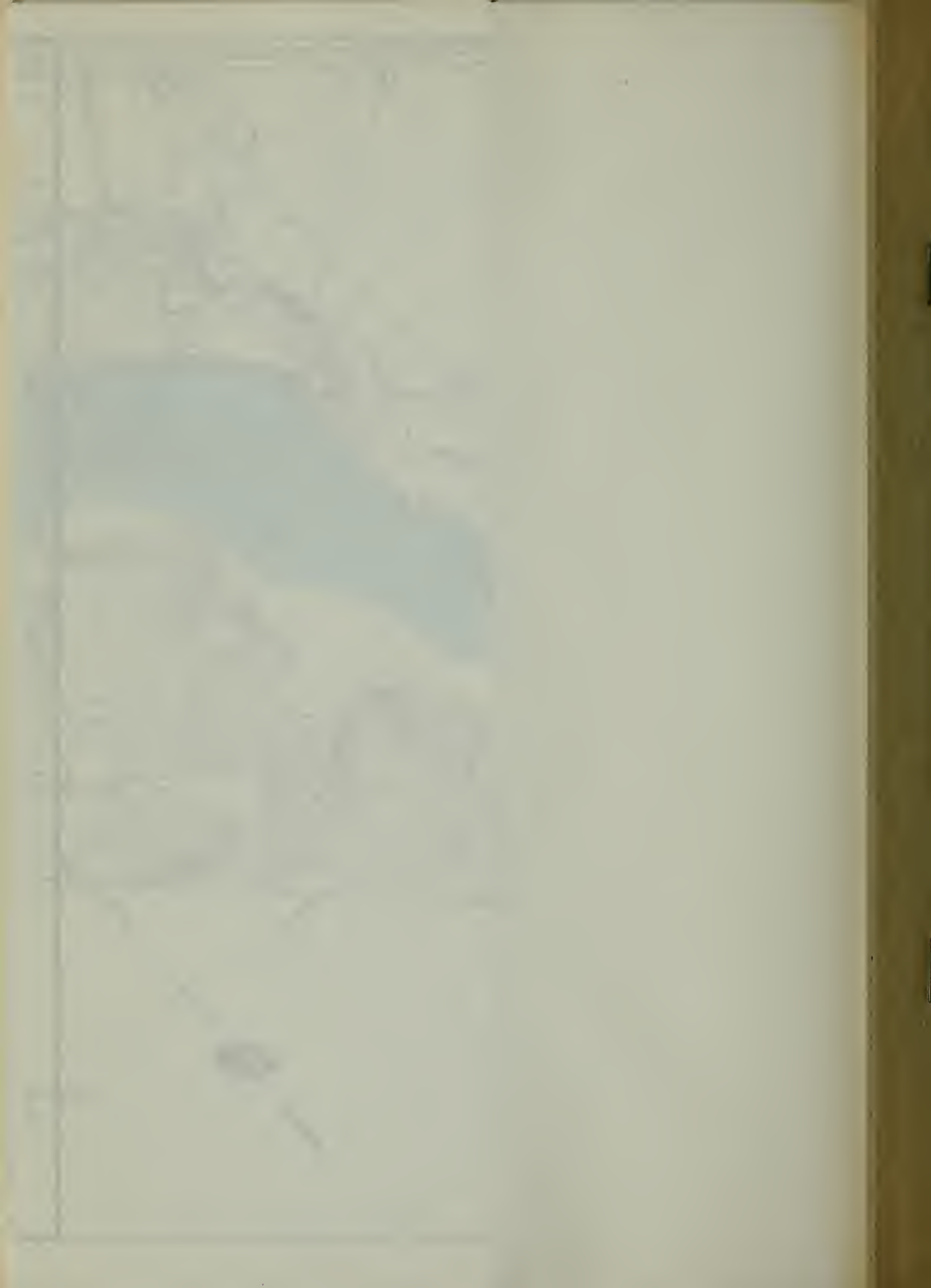
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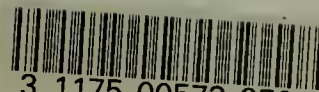
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